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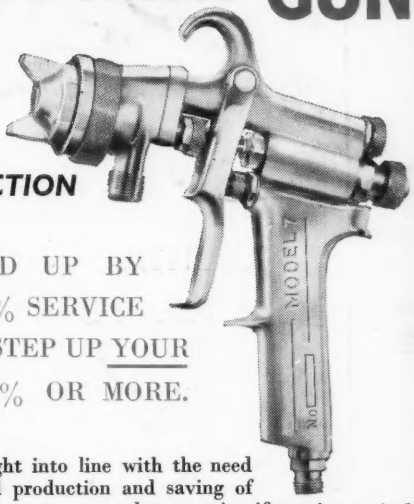

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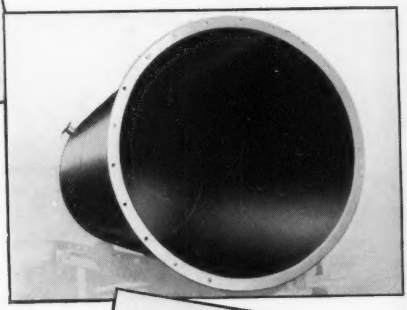

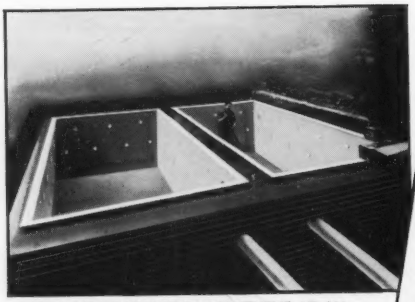

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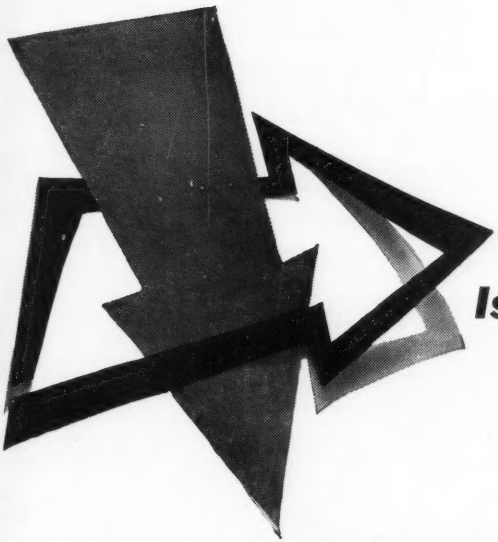

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ACIDITY (other than carbon dioxide) Max. 0.005% wt. (as acetic acid).

DISTILLATION RANGE (A.S.T.M.D. 268) Below 130°C.: none. Above 133°C.: none.

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Refractive Index	... n_D^{20}	1.4113
Vapour Pressure (mm. Hg.)	10°C.	0.9
	20°C.	2.1
	30°C.	4.6
Latent Heat of Vaporisation		104.0 cal/g.
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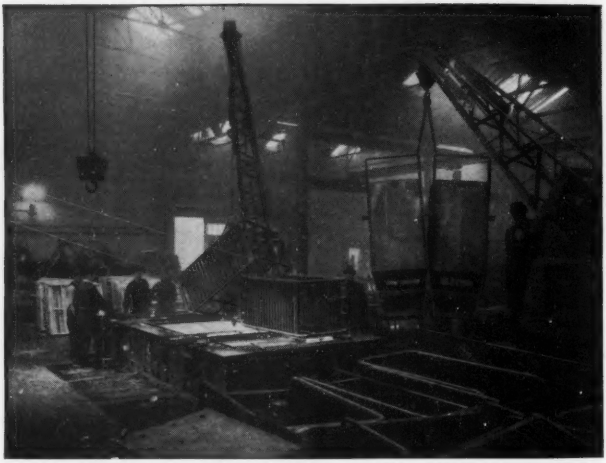

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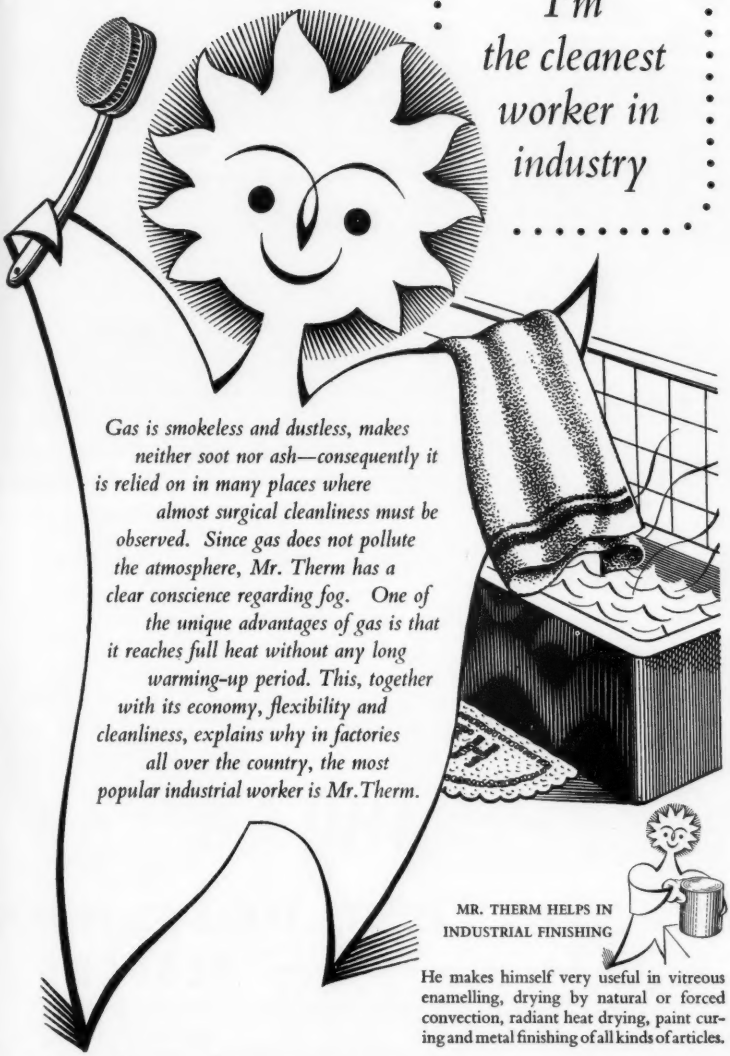

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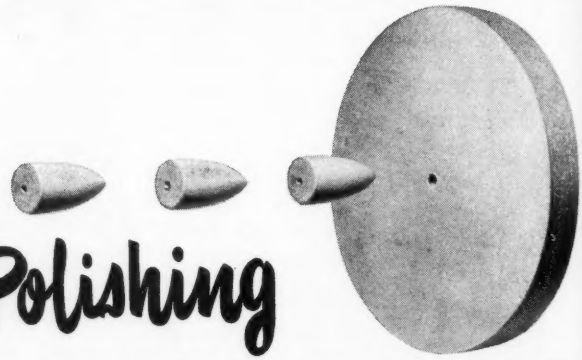

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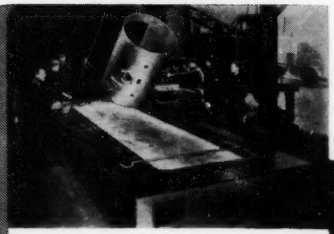

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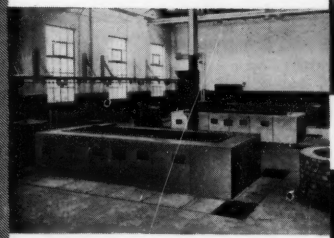

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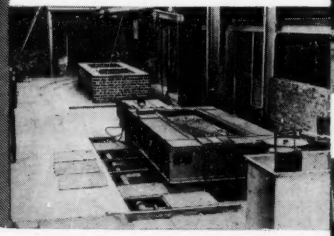

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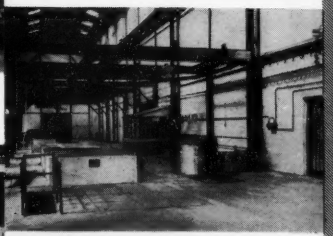

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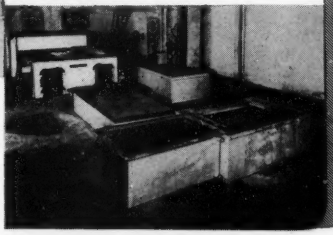

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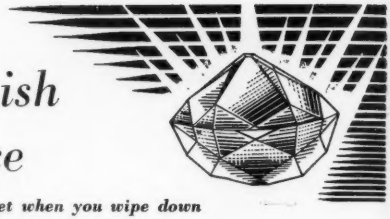

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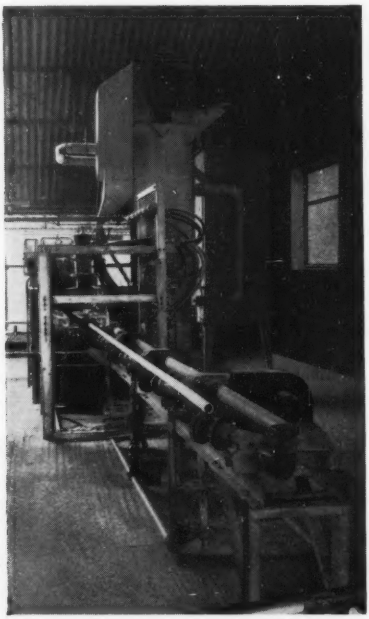

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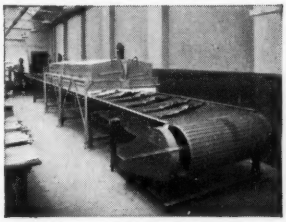

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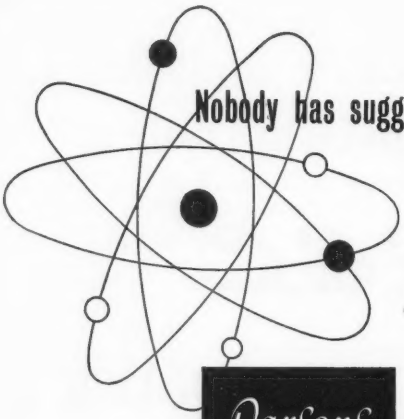

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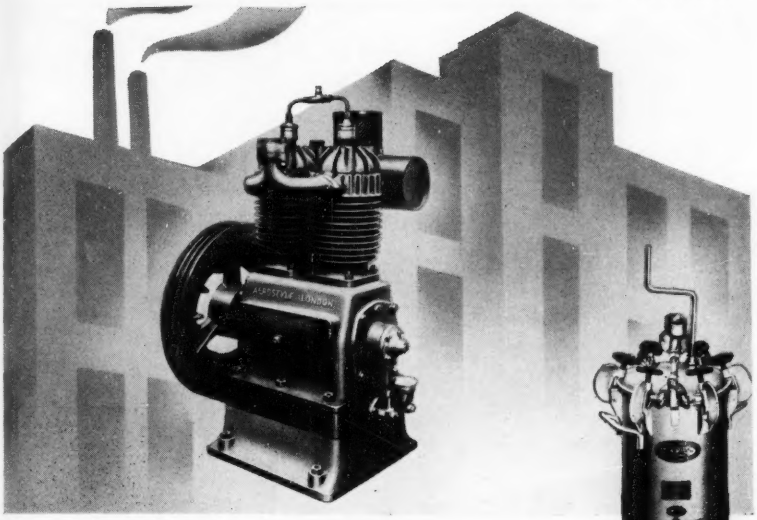

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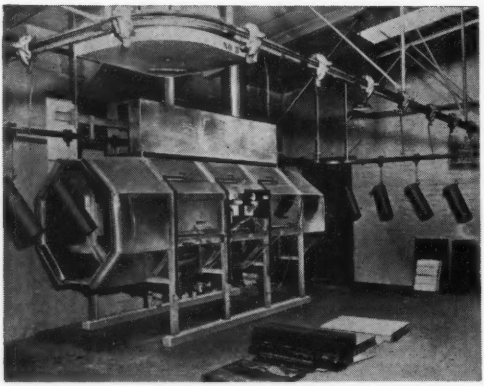

A tunnel of Bratt Colbran Radiant Units stoving finishes on food canisters. (By courtesy of Messrs. Grundy (Teddington) Limited.)

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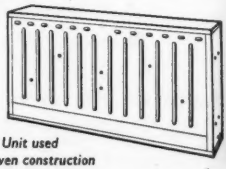

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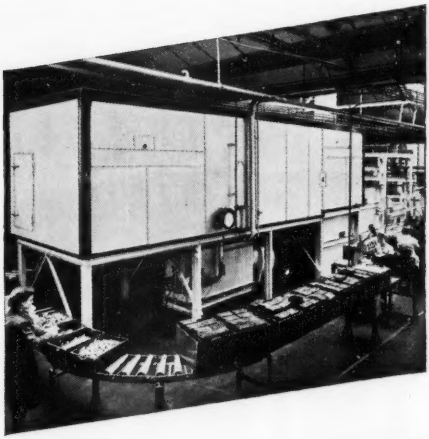

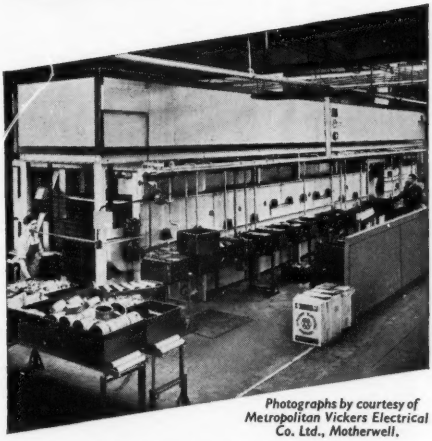

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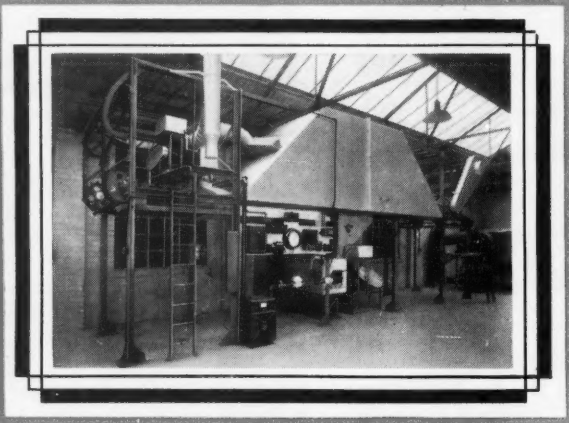

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FEATURE ARTICLES

	Page
A Tax on Industry	773
I.M.F. Spring Conference; Papers and Discussions	774
Research on Pickling, Hot Dipping and Tin Coating	806
American Finishing Developments	810
Heat Resistance	814
Three Coat Paint System for Transformers	817

MISCELLANEOUS

Barrel Processing	802
New Diaphragm Compressor	803
Steam Raiser for Plating Shops	804
Oil Drum Reconditioning	808
Accelerated Weathering Equipment	820
Dipping and Dip Lacquering	822
Names in the News	824
Advertisers' Index	827

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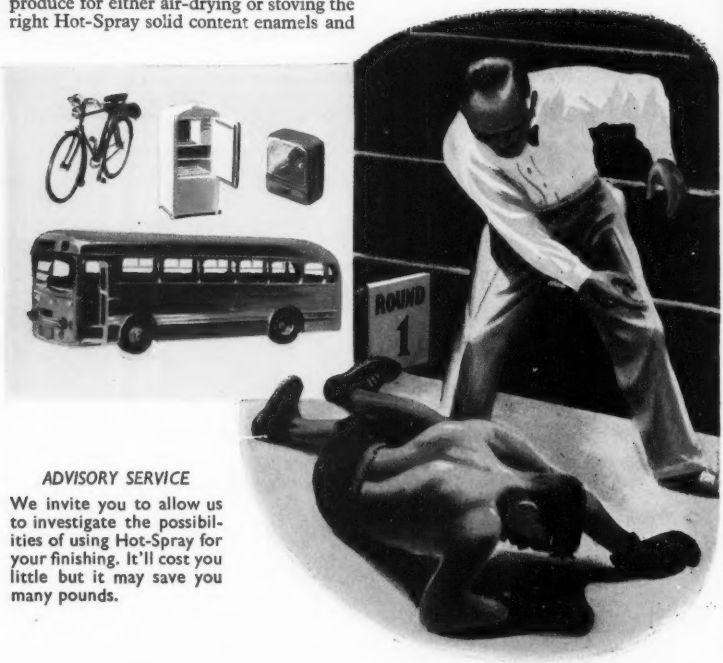

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Industrial Finishing

VOL. 5 JUNE, 1953 NO. 60

A Tax on Industry

ON the one hand Ministers of the Crown ask for increased productivity. And on the other they adopt a positive policy of Waywardness in doing that which only they can do to help!

Mr. Maudling, Economic Secretary to the Treasury and M.P. for Barnet states that Purchase-tax is "intrinsically unsatisfactory and *for that reason* is unpopular." But he adds that it is now "so deeply embedded in the fiscal system that it was not easy to prise it out again, and it was a large item for the Chancellor to throw away."

The Chancellor himself admits that "It was undesirable for the future economy of the Country for any industry to bear a tax of 100 per cent. on its products."

Mr. N. J. Campbell, Chairman, Industrial Light Oils Committee from Paint Industry House rightly points out in the *Times* of 13th June that the duty on the wholesale price of light hydrocarbon oils used for industrial processes is no less than 175 per cent! So, presumably the Chancellor views this tax even more undesirable.

The fiscal system with its present methods of deriving income has become completely divorced from reality. Obviously the only "wealth earner" of any importance in Britain is Industry. Without the wealth earned by industry there would be no fiscal system.

Industry is told from both sides of the House to increase its productivity and yet:—

1. No attempt is made to stem rapidly rising fuel costs.
2. No real incentive is given to Capital investment towards increased productivity.
3. There is a "fiscal tail" wagging an "industrial dog."

A pity indeed that some sales managers, works managers, factory executives and work people are too busy earning the nation's wealth to afford the time to become active in the Parliamentary system and thereby bring a little virile sense into a barren wilderness of economic realities.

Institute of Metal Finishing Spring Conference

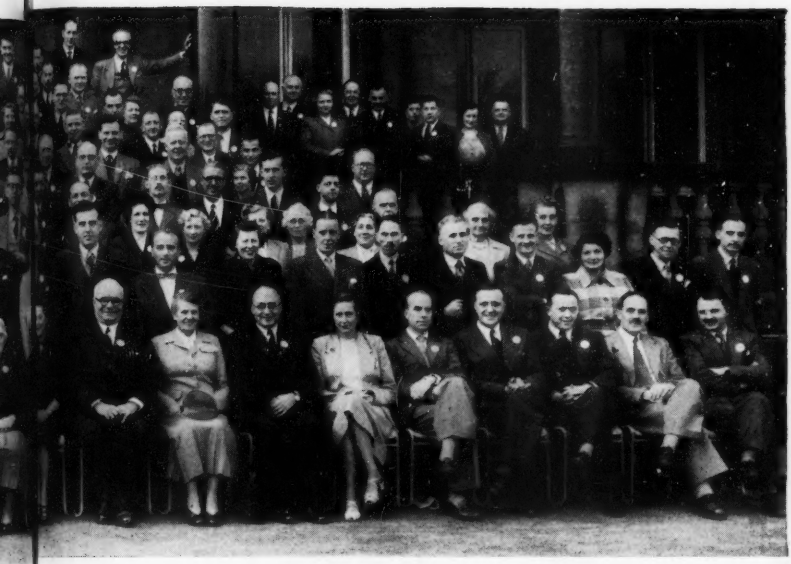
PAPERS AND DISCUSSIONS

THE PAINTING OF STEEL

By J. C. HUDSON, D.Sc., F.I.M., British Iron and Steel Research Association.

DR. J. C. HUDSON, in presenting his paper, said that if it were necessary to paint the whole of the steel produced in this country in one year alone the cost would be about £200,000,000. This country produced only about 18,000,000 tons of steel a year, and the world output must be between 150,000,000 and 200,000,000 tons. Fortunately, not all steel required to be painted; for reinforcing bars, for example, painting was unnecessary, and for railway lines it was impracticable. Great sums, however, had to be expended on maintenance. The classical example was the Forth Bridge. It was said that twenty-four men were employed in doing nothing else but paint that single bridge; it took 50 tons of paint to do it and occupied three years, and then they had to start all over again. Multiplying that by all the bridges and other steel structures in this country alone, it would be obvious that the interest in the protective painting of steel must be very acute.

In the second part of the paper, in predicting possible developments, he had tried to act as a stimulus rather than function as a prophet. He thought that the greatest step forward which could be made would be to render paints much less sensitive than most of



them were at present to the effect of bad surface condition of the steel, and also to make them much less sensitive to the effects of adverse weather conditions at the time of painting.

With the best will in the world, occasions arise when it is difficult or impracticable to secure the favourable conditions of temperature and humidity that are desirable when painting steel. There may be no option but to paint steel when it is wet. Although certain paints are believed to have been developed for this purpose, there is little, if any, published information about them. Systematic research on this subject would, therefore, be justified. Cementiferous paints or paints of the emulsion type suggest themselves immediately for use in this connection but other types of paint might prove suitable.

Paints for Metallic Coatings

Metallic coatings are being used more and more for the protection of steel of all types. The main metals used for this purpose on heavy structural steel are zinc and aluminium. The latter is applied almost exclusively by spraying and, to illustrate the extensive use of the process, it may be noted that in Great Britain one organisation alone already uses about 300 tons of aluminium for this purpose in the course of a year. As a good sprayed coating of aluminium weighs about $\frac{3}{4}$ oz. per sq. ft., the total area coated is roughly 15 million sq. ft. and represents about 30,000 tons of structural steel.

Somewhat different problems arise when painting metallic coatings on steel than when painting steel alone. Although some valuable information has been obtained by individual paint companies, the choice of painting schemes for this purpose is not yet fully understood.

Heat-resisting Paints

There are some applications—steel chimneys are an obvious one—in which a painting scheme has not only to protect steel from corrosion but also to withstand heat. There are several good heat-resisting paints on the market but it is doubtful whether any of them remain effective for long when subjected to temperatures above 300° C. in moist and polluted atmospheres.

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CORROSION PREVENTION BY PAINTS

By J. E. O. Mayne.
Department of Metallurgy, University of Cambridge.

PAINT has been used for a long time for the protection of metals against corrosion and during the last few years our knowledge of the manner in which it functions has been substantially extended. Formerly it was thought that protection was afforded in two ways:

1. Chemical Inhibition; here the paint contained constituents which inhibited the corrosion process and rendered the surface of metal passive.
2. Mechanical Exclusion; here the paint film was considered to be impermeable to the corrosive influences and thus corrosion was suppressed.

His paper can be summarised as follows: Paints can inhibit corrosion by modifying the anodic reaction; for this to occur the pigment must be either metallic, or soluble, or basic.

Paint films are so permeable to water and oxygen that they cannot inhibit the cathodic reactions. In general they function by virtue of their high electrolytic resistance; they readily acquire a charge consequently they are relatively impermeable to ions.

Soap formation is beneficial, since it renders the film less permeable to electrolytes, it also yields soluble degradation products, which suppress the anodic reaction.

DISCUSSION

MR. A. A. B. HARVEY (Chief Chemist, Briggs Motor Bodies Ltd.) said that: In the motor industry, the development during the last few years of the so-called chassis-less construction, in which the conventional chassis was replaced by a reinforced floor, introduced design factors which had given very considerable trouble in painting machinery to afford protection from corrosion. That was a case where the problem of corrosion and its prevention, and the pursuit of mechanical efficiency, had produced a state of affairs where the economies had to be carefully studied to balance the increased difficulties in corrosion protection against the benefit derived from the advance in engineering construction.

In the case of preparation and application in adverse weather conditions, Mr. Harvey's industry were fortunate. They had to put in elaborate cleaning machinery and they had to install air conditioning plant so that they could produce motor-cars of pleasing appearance, and by so doing, of course, they gave themselves constant atmospheric conditions in which to apply paint. It was important to observe, however, that, as Dr. Hudson pointed out, if paint were applied to a clean grit-blasted steel the result was not necessarily good. Their industrial experience in pre-war years, before phosphating became of general application in the motor-car industry, indicated that the amount of pre-treatment required to give good adhesion might be small on a steel with a reasonably good surface. The standard treatment had been a light phosphoric acid wash, usually with one of the proprietary alcoholic phosphoric acid cleaners; and the many cars which were running about today in their original paint showed the efficacy of that cleaning in promoting good adhesion.

DR. S. G. CLARKE (Armament Research Establishment) said: It was particularly welcome to see Dr. Hudson's reference to the significance of thickness in paint films. That factor had been very disappointingly ignored in the past, and the attention which Dr. Hudson devoted to it represented, therefore, a great advance in tackling the subject. It was of particular importance at a Conference of the Institute of Metal Finishing, because the Institute had grown out of the old Electrodepositors' Technical Society, the members of which had been aware for many years of the significance of thickness in metal coatings and had been waiting for the paint people to

look at their films in the same way that the metal coating people looked at theirs.

DR. S. WERNICK said that the two papers served to bring out one or two fundamental differences between painting and the finishes with which members were so much more familiar and which they had discussed so much in the past, obtained by deposition. In particular, their approach to the business of preparing a metal surface had obviously to be fundamentally altered. It might come as a shock to those who, in plating practice, were so very careful to remove not merely the organic contaminants but the very last trace of oxide before proceeding to the coating processes to realise that it was possible to paint on surfaces which the average plater would consider to be contaminated or dirty.

He had been a little shocked by the extent to which Dr. Hudson was prepared to go in painting a surface which not merely had millscale on it, which at least was firmly adherent and presumably was not subject to further chemical change, but actually had rust present. Dr. Hudson seemed to suggest that it would be satisfactory to paint on a surface where rust was present. That seemed to be a counsel of despair.

He would like Dr. Hudson to say that he did not seriously advocate leaving rust films to be painted on unless there was no other way out, because a doctrine of that kind might result in defective work.

On the subject of future developments, it would be very interesting to learn what had been done in the field of hot spray lacquers. Dr. Hudson referred to the desirability of cutting down the number of paint coatings which were applied, and with that there there would be general agreement. In the development of hot spray lacquers claims had been made that had been done to some degree.

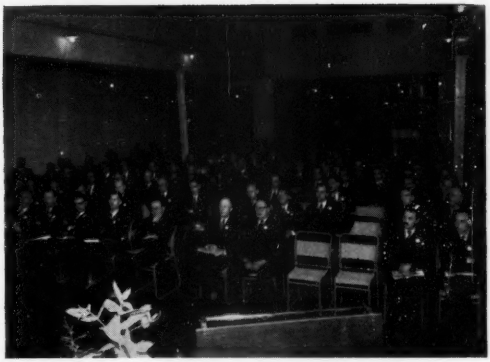
Another field to which it would be useful if the paint research workers would pay some attention was that of wash primers, the most successful were what were known as the two-pack primers, where the phosphoric acid and the primer proper were mixed and then applied. They had the obvious drawback, however, that they had to be made up as and when they were to be used. That was quite satisfactory for large structures, where the paint could be made up as required, but would be a very serious drawback in production where one was using, for instance, a tank of paint and immersing components, so that that paint had to be available for days on end and could not be made up periodically. What was wanted was what had come to be known as a one-pack primer, where one had the two elements, which were not, unfortunately, very compatible with one another, phosphoric acid and the paint vehicle. One was apt to affect the properties of the other. If, however, it were possible to obtain a mixture of that kind which would be permanent and stable it would be a really important contribution.

Dr. J. C. HUDSON asked leave to make it clear that he did *not* advocate painting over rust, and that he was in agreement with Dr. Wernick on that point. A study of his paper would show, he thought, that their views did not diverge. Most of the details related to the protection of steel exposed to atmospheric corrosion. The strange fact was, and there could be no doubt about it, it had been demonstrated both by small-scale experiments and by tests on ocean-going liners—that under conditions of complete immersion paint might not adhere perfectly to a freshly descaled surface. Some paints did so and others did not. If one were painting a ship's plate which was going to be subsequently immersed in the sea, it was better to allow the plate to rust to a slight degree before the bottom composition was put on, or alternatively to treat it with a phosphoric acid wash. In that respect the painting of steel which was to be immersed differed radically from that of steel exposed to the atmosphere.

Mr. W. E. CATTLEY (Walterisation Co. Ltd.) congratulated the authors on their papers and said that it was most encouraging to find that the Institute, having spread its ægis to cover painting, had made such an excellent start.

Dealing with the question of cold phosphating, he said that he used that term in preference to the more general term of phosphoric acid washes because what he was mainly interested in was basically phosphoric acid and a

The Deputy Mayor of Harrogate, the President and Dr. Cuthbertson, at the opening of the Conference. The Mayor was unable to attend on this occasion



Scene inside the lecture hall of the Hotel Majestic during one of the Technical Sessions. This new lecture hall was in use for practically the first time

Dr. J. W. Cuthbertson, with two interested onlookers, enjoys a moment of relaxation at a garden fete held on the hotel lawn between technical sessions

metal phosphate, and the chemical conversion of the rust into a phosphate coating. There they had had some excellent results in two respects: one was an increase in paint life of three to four times, and the other the effect on a millscale surface. The cold phosphating solution removed the millscale in quite a short time as a complete scale, leaving a film of rust behind which then could be in turn treated with the cold phosphating solution and a great increase in paint life obtained.

He was very interested in Dr. Hudson's reference to the removal of scale and rust by pickling, and in that connection there had been a report a short time ago of a paper in America on the reduced cost of phosphoric acid pickling using an ion exchange plant, so that the phosphoric acid itself could be regenerated. That had aroused tremendous interest both in the U.S.A. and in this country, because, of course, the advantages of phosphoric acid had long been recognised in this connection, but the cost had been somewhat prohibitive. The process in question had enabled the cost of phosphoric acid pickling to be brought down below the cost of sulphuric acid, and that had aroused much interest. At least one company was talking of putting in plants 30 ft. long for phosphoric acid pickling.

The PRESIDENT asked whether Dr. Hudson would care to make any comments on the influence of paint adhesion on paint durability. For example, he said, it was known that phosphate treatment might in some cases actually reduce the paint adhesion, though certain of the trade claims for phosphate treatment suggested otherwise, yet there was no doubt that a phosphate treatment would increase the life over an etched steel surface, where there was immediately a high degree of bonding. Had Dr. Hudson any information on that?

Dr. J. C. HUDSON replied that he could not speak with authority on phosphate coatings. There were many phosphating processes, and all those processes were undoubtedly of genuine value and had their uses. The only criticism which he might make was that some people sometimes tried to push the use of their processes where other processes would be more economical, but that was a commercial weakness not confined to that type of industry. It was quite true, and he thought that everybody in the industry would admit it, that in certain circumstances phosphate coatings might reduce adhesion, but he also thought that it was fair to state that in most of the cases where that had happened it had been because the wrong type of phosphate coating had been chosen.

Mr. H. A. HOLDEN (Pyrene Co. Ltd.), referring to what had been said about the reduced adhesion of an organic finish on a phosphate coating, expressed the opinion that all phosphate coatings would increase the adhesion of an organic finish provided one defined how one was going to measure the adhesion. That was where the trouble came in. Some people said "If we phosphate this piece of steel and then bend it, your coating flakes off, so that by phosphating it we have reduced the adhesion of the organic finish." If one put the organic finish straight on a piece of steel and bend it, the organic finish, it was claimed, did not flake off. The answer was that if one phosphated it, the phosphate coating bonded the organic finish so tightly that if one bent the piece of steel there was no chance of any slip, and the organic coating packed up. (*Laughter.*)

RECENT DEVELOPMENTS IN METAL SPRAYING BY THE POWDER PROCESS

By WILLIAM MCDERMOTT, B.Sc.
Works Chemist, Schori Metallising Process, Ltd., London.

GENERAL principles of metal spraying by the powder process were described, and an account given of an improved powder-spraying pistol. In this apparatus, powder is conveyed into an oxy-gas flame by any desired conveying gas under pressure: this allows the application of denser, less oxidised and better adherent coatings of zinc, aluminium,

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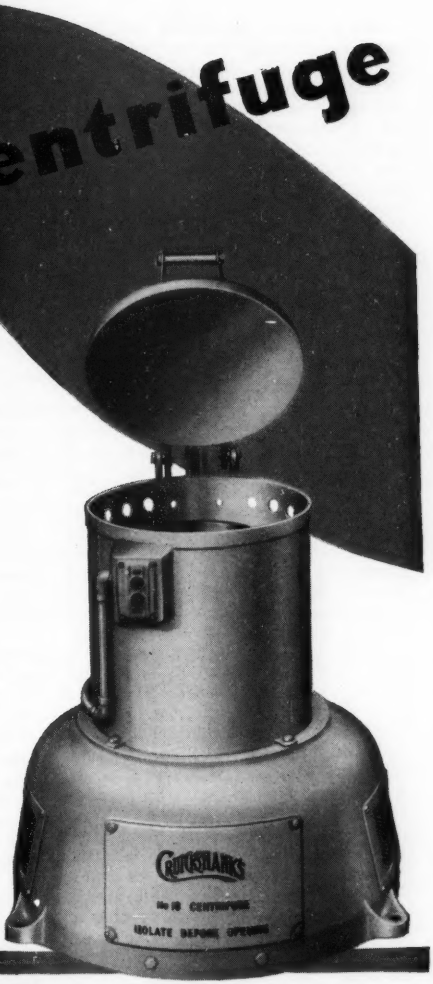

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etc., than does the older spraying pistol wherein the powder is sucked into the pistol in an air stream, and also the spraying operation is faster and more efficient.

A simple quantitative adhesion test for sprayed metal coatings was described.

Some recent specialised techniques and applications were outlined, including the production of sprayed coatings of very low and of very high resistivity, the spraying of steels, the production of "aluminised" coatings by powder spraying followed by heat treatment, the production of hard, non-porous surfaces by "flaming" special sprayed coatings, and the improvement of the adhesion of zinc and aluminium coatings to be had either by an undercoat of sprayed steel or by preheating the base metal.

Metal spraying has made considerable progress over the past few years, both commercially and in its technical development. The use of sprayed metal coatings in the metal finishing industry is well tried and established; metal spraying takes its place in well defined applications alongside plating, painting and other finishing processes. Its possibilities appear to be very wide, and new uses are being found constantly wherein its unique features are of particular advantage.

RECENT ADVANCES IN METAL SPRAYING BY THE WIRE PROCESS

By W. E. BALLARD, F.R.I.C., F.I.M.
Metallisation Ltd., Dudley.

THERE is a greater use of metal-spraying equipment per head of the population in Great Britain than in any other part of the world, and the demands on the industry seem to be growing—not because the character of the metal-sprayed coating has been altered by any recent development, but because the unique properties of the deposit are now more generally appreciated. In the early days of development, it was commonly believed that metal spraying might be a serious competitor to electrodeposition, but it is now realised that, in general, sprayed deposits are not competitive with any other form of metal coating. They have fields of utility peculiar to themselves owing to their own peculiar properties.

At the present time the gas system of spraying is predominant; in other words, the wire to be sprayed passes through an oxy-fuel-gas flame and is fused therein, the liquid being divided into small particles by a gaseous stream. To produce cheap metal coatings, therefore, it is necessary to reduce:

(1) Metallic losses.
(2) The consumption of oxygen and fuel gas per lb. of metal sprayed.
(3) Air consumption.
(4) Labour costs, by making the process as rapid as possible.

This last factor is very important in development because as time goes on, the cost of labour increases and, in manual working, labour is a high proportion of spraying costs. Spraying cannot be considered as a "White-coated industry" unless it is fully mechanised, and therefore as time goes on labour will only be attracted to it by high rates of pay or by development of special machines.

MR. W. E. BALLARD said that thirty years ago the amount of metal sprayed in a year in this country was 1 cwt. Last year, one works alone sprayed over 200 tons of aluminium, and the largest job ever done on metal spraying meant coating 35,000 tons of structural steelwork. It was obvious, therefore, that in thirty years an industry had grown up in this country.

It might be asked why both he and Mr. McDermott had dealt with automatic plants. So far as they knew, Great Britain was the only country in the world which was as yet making automatic spraying plants on a considerable scale. In that respect they

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were in advance of American industry, and that fact was worth noting.

For the future it seems that major improvements must be in the direction of cheapening the coatings and more particularly the preparation of the surface. Improvements in the structure of the deposits are also possible, but it must be remembered that the porosity of sprayed metal confers on it its oil-retaining properties, and the presence of some pores and some oxide are responsible for the remarkable protection given by aluminium coatings. If spraying were developed to give smooth even coatings free from pores, they would resemble cladding and might not retain the advantages which they have today.

DISCUSSION

DR. F. A. CHAMPION (British Aluminium Co. Ltd.), commenting on the modern development towards mechanisation, said that a good deal had now been done which he thought had convinced most people of the very useful work which could be done by metal spraying, but often the biggest difficulty was the cost. The development of the mechanisation of spraying was the answer to that problem. and still more developments could be looked forward to in that connection.

Mr. McDermott referred to preheating of the steel as being a permissible alternative to shot-blasting as a preparation. One wondered whether it could be used as an alternative to shot-blasting. One looked for a commercial alternative to shot-blasting because it had disadvantages in some cases. He also used the term "aluminising" for the coatings of aluminium heat-treated to provide protection at high temperatures. That term was a little ambiguous and might cause confusion through people not realising just what type of coating that was.

Mr. A. WALMSLEY (Burco Ltd.) asked whether it was possible to produce a sprayed metal film which was extremely smooth. He believed that difficulties arose in stoving synthetic enamels over metal-sprayed components due to the expansion of entrapped air. With regard to the reclamation of worn parts, he asked whether it would be possible to reclaim such things as printing rollers to give a surface suitable after machining for further engraving.

Dr. T. P. HOAR (University of Cambridge) said that he had suggested the zinc coatings under aluminium which Dr. Champion thought were theoretically wrong, and Mr. McDermott was not responsible for them. They had had experiments in progress for almost two years now, which seemed to show that, even if it was theoretically wrong to put zinc under aluminium, in practice it worked out very well. He had had specimens exposed at Kure Beach, London and Cambridge, with aluminium on top of zinc, and none showed any corrosion after eighteen months. Zinc-aluminium alloys were also showing up well in the same series of tests.

Turning to the mechanised plants which the two authors had rightly pointed out were the biggest feature of the advance in metal spraying of recent years, he would like to congratulate both authors and their companies on the obviously healthy competition which had put this country ahead of the U.S.A. on this matter. Perhaps the competitors would not mind if he said that they looked pretty healthy themselves, too.

Mr. H. LOW (J. P. Fielding and Co. Ltd.), commenting on Mr. Ballard's reference to the use of sprayed aluminium for reclaiming worn or spoilt surfaces, and particularly bearing surfaces, said that it would be interesting if some comparative figures could be given for these sprayed aluminium built-up coatings and the hard chrome plating to which Mr. Ballard referred. Mr. Ballard said that the claim made for the sprayed aluminium was not the hardness, which was much inferior to hard chrome electrolytically deposited, but the porosity, and the capacity of the porous coating to take up and hold a film of lubricant. Chromium, of course, was also a porous coating—a fact which worried many electro-depositors—and there was at least one process which had been developed for the production of a porous hard chrome which would have a similar effect to that claimed by Mr. Ballard for his aluminium coatings.

A LABORATORY STUDY OF A COMMERCIAL METHOD OF ELECTROPLATING ALUMINIUM

By J. EDWARDS, PH.D., B.SC.† AND C. J. SWANSON, B.SC.‡
† Head of Electrodeposition Section, B.N.F.M.R.A., London.
‡ Formerly Investigator, B.N.F.M.R.A., London.

THE results were presented of a laboratory study of an electrolytic method of plating on aluminium. The permissible variations in the duration of the successive steps in the process have been determined and it has been established that stoving is essential to the production of strong adhesion. However, it has been found that stoving is unnecessary if a zincate immersion deposit is applied to the aluminium surface and stripped off in nitric acid prior to the electrodeposition stages of the process.

A tentative explanation of the results was advanced based on the view that the application and stripping of an immersion deposit improves the uniformity of the oxide film covering the basis metal surface and that stoving improves adhesion by producing sintering of the zinc deposit.

ELECTROPLATING ON MAGNESIUM

By H. K. DELONG
(The Dow Chemical Company, Midland, Michigan, U.S.A.)

THE electroplating of magnesium and magnesium alloys has been the subject of much study. Attempts in the past to develop a successful practical process have not been, in general, too encouraging. Various methods have been advanced and are mentioned in the patent literature for obtaining electrodeposits in both aqueous and non-aqueous media. The problem of obtaining a good intimate bond of the electrodeposit has been a major consideration. Such factors as the position of magnesium in the electrochemical series and its film-forming characteristics, which are such that hydroxide forms on the surface in most aqueous solutions before metal ions can be reduced, have posed a problem difficult to overcome except by special techniques.

The process of electroplating magnesium and its alloys, using as a base a zinc immersion coating formed by treatment in an alkaline pyrophosphate bath, was described by the author. This development opens up a field for the use of magnesium in many applications where a bright corrosion- and tarnish-resistant surface is essential or increased wear resistance is desired. The practicability of the process is now fairly well established in actual production processing. The protective values of the various electrodeposits, particularly of the decorative chromium type, have been determined and are reported.

DISCUSSION

Mr. A. W. WALLBANK (Managing Director, Ionic Plating Co. Ltd.,) said that the paper was a pointer to how research bodies such as the B.N.F.M.R.A., could co-operate with platers in tackling some of their processes in that way, using such a process as a basis for its preliminary investigations at any rate. It was gratifying to notice how the work which had been done confirmed the value of the process in question; the research workers obtained good adhesion, on the same lines as was done in the shops, and confirmed the criti-

cal nature of some of the stages. It was comforting to platers to find that their observations were confirmed in a research laboratory.

What was the value of the Vogt process? It would plate on composite assemblies, and any article hung on a copper wire or on a jig not made of aluminium was automatically a composite bimetal assembly. The process did work, but there was one feature of it which had not been wholly investigated. The Vogt process did not seem so prone to give rise to the delayed corrosion effect found with the zincate process, where there was a deposit which seemed perfectly good immediately after plating and perhaps for two or three weeks after that, and then, even in store, seemed to decay and corrode along the interface. That seemed to be a point where the Vogt process was superior to the zincate.

He would like to know whether the B.N.F.M.R.A., had looked at the nickel solution itself. Vogt had claimed, as did most of those who followed him, that an important feature of the process was the very low chloride in the nickel bath, and it would be interesting to know the view of the B.N.F.M.R.A. on that, and whether or not they agreed that a low chloride in the nickel was a desirable feature of either process.

Mr. A. W. BRACE (Aluminium Development Association) said that he wondered whether more attention might be devoted to seeing whether a copper plating bath could not be used in place of the brass. This had obvious attractions. With regard to the experimental technique itself, he was surprised, in view of Dr. Bailey's work, that the authors used the A.S.T.M solution for the immersion dip, especially as the A.S.T.M. solution was outside the optimum range for maximum adhesion efficiency. He wondered whether the conditioning sequence used in the Vogt process had ever been tried followed by the double zincate technique, because he felt that it was likely to give as good results as the modified process used by the authors and should have certain production advantages.

He would like to make a few comments on the paper by DeLong. It would have been helpful to have more information, for the benefit of readers in this country, on the A.S.T.M. method of assessing the deterioration of plated coatings. Methods which worked well for plated deposits on steel were misleading on metals at the other end of the scale such as zinc, aluminium and magnesium. From electrochemical considerations he agreed with Dr. Cuthbertson that one would not have expected aluminium to be worse than magnesium, and in fact he had been told by J. D. Edwards, of the Aluminium Company of America, that properly-plated aluminium specimens with 0·002 in. of nickel on them had withstood more than three years exposure in various outdoor corrosive environments.

Mr. H. A. van OOSTERHOUT (N.V. Metallic Industry, Loosdrecht, Holland) said that in their laboratory they had carried out investigations on the elecrolytic treatment of aluminium. They used three processes for plating aluminium. For alloys containing more than 3 per cent. silicon they used a solution containing zinc sulphate and hydrofluoric acid, a double vehicle. The second process was normal zincate solution, and after the zincate treatment they copper plated. The third process was double zincate solution, but using after the second dip a solution containing sulphuric acid and hydrogen peroxide. After that dip, the aluminium could be plated brightly directly.

Mr. H. J. BACHE (Electro-Chemical Engineering Co. Ltd.), referring to Mr. DeLong's paper, said that since this work seemed to have very considerable value commercially he would like to ask Dr. Cuthbertson whether further information on two small points could be given. In the formula for the zinc immersion process, zinc sulphate monohydrate was referred to specifically. Was there any reason why the hexahydrate should not be used there? He believed that it could be more easily obtained. Secondly, the paper referred to the fact that the fluoride concentration of this solution required careful observation. Could any further information be supplied about the methods used for controlling the

fluoride concentration of the solution?

Mr. A. J. F. HILL said that the process, in spite of the tendency of manufacturers to say of plating processes that they were very complex, and so on, seemed to be a reasonable one, but he would like to know whether there were any common alloys of magnesium which one was likely to meet in manufacture which were going to give special trouble in following out this process, and whether it would be considered that preheat treatment beforehand would help or hinder the process in any way. Would it be advantageous to give a low preheat treatment beforehand? He would also be very interested to know whether there were any quantitative data on what was done to the basis metal. What micro-finish was given to it? What chances were there of bright plating afterwards, and was it possible to give a specular finish with these processes? Were there any automatic plants at present carrying out the process anywhere?

Dr. F. A. CHAMPION (British Aluminium Co. Ltd.,) said that in the adhesion test which Edwards and Swanson had used, the metal had been bent backwards and forwards to fracture, and it must be expected that the number of bends would vary with the mechanical properties of the alloy. That might have introduced an error into the method. Possibly it had not been used as precisely as that, but for the sake of posterity it would be useful to have details of the condition of the various alloys used, to give some guidance on that point.

The process as developed looked attractive from the point of view of being able to use bright nickel plating. He did not know whether it was heresy to do so at a meeting of the Institute, but he would suggest that bright nickel plating should be used with some caution, because he wondered whether that, in fact, was an important cause of the poor corrosion resistance of modern plating, even on steel and brass; and, where one was plating a metal such as nickel or aluminium, if that was due to omitting the buffing to seal the pores in nickel plating it was going to be more important, and an assurance should be given on that point.

Dr. S. WERNICK said that he had some difficulty in reconciling the results given in the paper by Mr. DeLong with some of the aspects of the theory. One was dealing with a highly corrodible metal, magnesium. As had been pointed out by Dr. Cuthbertson, it was practically impossible to devise any means of protecting it by anodic processes. Dr. Wernick could speak feelingly about that, having some time ago also embarked on that rather hopeless technique. That metal was coated first with zinc and then with copper and then with nickel. Even neglecting the fact that magnesium was itself highly corrodible to start with, the zinc and copper which were then deposited on the magnesium themselves formed a rather formidable couple, and once one got to the nickel coating one had a highly corrodible mess.

His belief was that the best results which the paper recorded arose from the fact that the nickel coating was fairly thick and reasonably impermeable. A study of the graphs would show that good results were obtainable at round about a thickness of 0·002 in. of nickel. He thought that they would all like to be in a position where they could economically and commercially plate 0·002 in. of nickel on most of their products; and, while the development described was one which they wanted to know about and to encourage, it was as well to put it into its correct practical perspective.

Dr. J. EDWARDS, replying first to Mr. Wallbank, said they had not done anything about the nickel bath and probably before they came to the nickel bath they must consider the brass bath, because in the zincate process one could apply a thick deposit of copper from the Rochelle solution and one would hardly expect it to be necessary to have a critically-controlled nickel bath. As that could be done with the modified process, probably the same would apply.

The question of the brass solution had been raised by Mr. Brace. The authors agreed that the brass solution was a rather strangely compounded one. They had found in their

preliminary survey that good adhesion was obtained, but that if the treatment in the brass solution was carried on for too long it did not produce an ideal deposit. They had put that first on the order of priority, to change the solution in order to improve the process.

Mr. Brace asked why they had used the A.S.T.M. solution for the zincate deposit when in the previous publication they had shown that another solution would give slightly better results. They had not, of course, finished examining all the possible combinations, but they chose that solution because they regarded it as the standard zincate solution. They would certainly vary that stage as well as the others, and in fact they had already done so.

Dr. Champion referred to their adhesion test and asked whether they had taken into account the difference in mechanical properties of the different alloys, and he asked for more details of the condition of the various alloys. The authors could not give him offhand the service conditions of all the alloys—i.e., the mechanical conditions—but they would probably be swamped by other differences between the different alloys. There was a considerable difference in hardness and other properties. The authors tried to take care of those by reducing the adhesion test classifications to three. They had only three classes: weak (which meant that the stuff more or less dropped off); medium strong (where one could by exerting force pull it off); and strong (where one could not pull it off at all, however hard one tried). It was only a qualitative method and was applied to different base metals. So long as one did not try to multiply the degrees of adhesion it was probably fairly safe. There was a temptation to distinguish between degrees of adhesion further than that, but so long as that was ignored one was probably fairly safe.

Dr. J. W. CUTHBERTSON, replying on behalf of the absent author, to the discussion on the paper by DeLong, regretted that he did not know the answers to the questions which had been put. Mr. Brace, for example, had referred to the possible shortcomings of the methods of testing reviewed in the paper. Dr. Cuthbertson could not comment on that, as he did not know any more details than those given in the paper; he did not know the answer to either of the questions put by Mr. Bache. Turning to Mr. Hill's comments, from the information given in the paper it did not seem that there should be any difficulty in plating the ordinary magnesium alloys. It would be noted that the times of treatment in the zincate dip given referred to aluminium-containing alloys and to "non-aluminium-containing alloys," presumably the zinc-containing casting alloys. No reference was made to the binary magnesium-manganese alloys; those alloys might be exceptional, and he would not commit himself with respect to them.

Heat treatment would in some instances, he thought, be an advantage, a homogenising treatment. Anything which would remove segregation would undoubtedly be of some assistance. There was no reference in the paper to the extent to which the surface was roughened by the treatment given, and all the work was based on polishing, with the possible exception of the copper bath, where there was a reference to possible bright deposits.

He agreed in the main with what Dr. Wernick had said, but would cross swords with him on one point. Dr. Wernick built up a picture to support his contention that this magnesium-zinc-copper, so-and-so mixture was a "corrodible mess." Dr. Cuthbertson did not think that the situation was very different from that of aluminium. Magnesium and aluminium were not widely different in electro-chemical properties. One was accustomed to think of magnesium as a less resistant material than aluminium, but aluminium was able to form a good protective oxide coating and so its serviceability was higher than that of magnesium. When, however, a zinc coating was put on, and so on, the question of the oxide coating did not arise at all, and he was not convinced that the case for magnesium, based on electro-chemical theory, was very much worse than for aluminium. He thought that it was worse, but not so much worse that one need be frightened off it.

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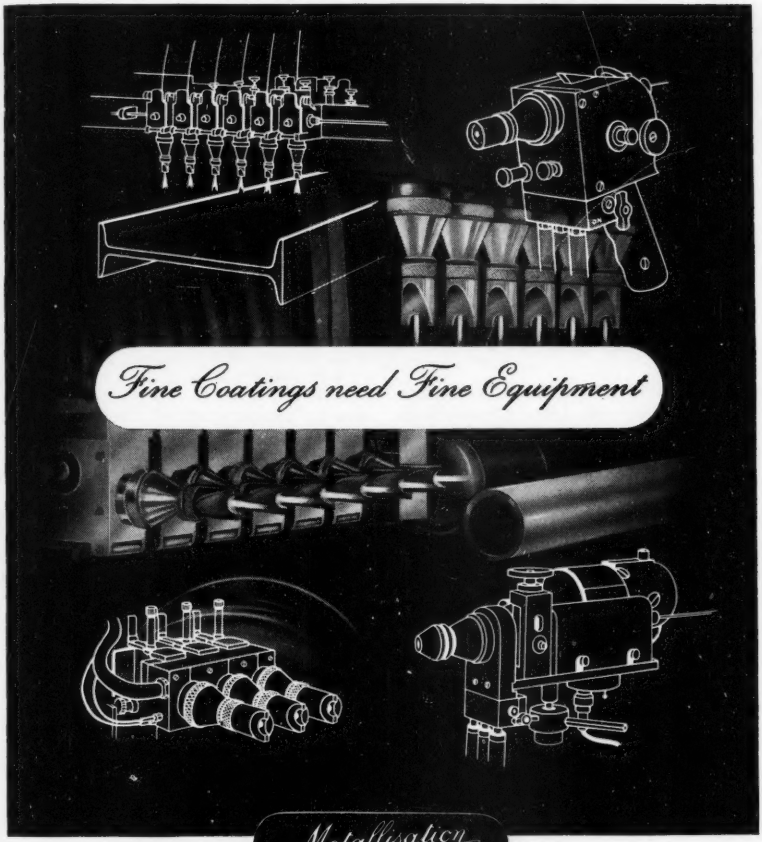

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COMPLEX FLUORIDES FOR THE DEPOSITION OF TIN AND TIN ALLOYS

By A. E. DAVIES, R. M. ANGLES AND J. W. CUTHBERTSON

THIS paper dealt with the more recent work on the deposition of tin from the stannous fluoborate bath, relating mainly to the effect of addition agents, to anode sludging, and to electrode efficiencies. Preliminary work on the deposition of tin from the stannous fluosilicate bath was outlined.

Some work has been carried out on the deposition of tin-nickel, tin-cadmium, and tin-zinc from fluoborate baths, and on the deposition of tin-cadmium and tin-zinc from fluosilicate baths. This work is still in its early stages and the progress made to date was summarised.

DISCUSSION

Dr. N. PARKINSON (Chief Chemist, Mallory Batteries Ltd.), in a written contribution read by Dr. T. P. Hoar, commented on the complexing of stannous tin in fluoborate solutions, he stated that it was suggested by the authors in the general discussion that tin was partly complexed, though not to such an extent as in fluoride solutions. One would expect relatively small amounts of free hydrogen fluoride in the baths with which the authors had been concerned. However, if one assumed some ionisation of this free acid to give some free fluoride ions it was possible to envisage some small degree of complexing of tin by the following method:

$$Sn^{++} + 4F = [SnF_4]$$

If this did take place, increased hydrolysis of the fluoboric acid, due to removal of fluoride ion, would be expected, and it would be of interest to know whether that state of affairs was actually found. Did the authors consider that the mechanism suggested played any role in the complexing to which they referred?

Turning to the question of alloy plating baths, he would like to ask the authors whether the presence of fluorides used, up to 50 g. per litre, as they suggested, was necessary to obtain stable baths, bearing in mind that a high degree of acidity was necessary for stability in the stannous fluoborate electrolyte for tin plating.

Mr. G. D. DENYER (Glacier Metal Co. Ltd.), dealing with the possibilities of application of the tin-base alloys in question of commercial practice, said that his company were particularly interested in tin-base alloys of low hardness. They used a bath which purported to give 5 to 10 per cent. antimony, with anodes of 8 per cent. antimony. When they did their first few tests they got 10-12 per cent. antimony. They then conducted a statistical experiment, varying the other factors over a period of time, and the results obtained followed a curve of the type shown (the author drew this on a blackboard) ending up with 8 per cent. antimony after a certain number of ampere hours. The effects of variables such as current density, temperature, and methods of preparation of the specimen were completely swamped. The overall effect of the condition of the bath should have made it clear that the anode was not dissolving at the rate desired to give the corresponding correct deposit on the cathode.

The anodes contained a heavy black sludge. They did not wash it off after each experiment, because that would have introduced a variable. When the heavy black deposit was analysed, 60 per cent. of antimony was found in the deposit, whereas there had been only 8 per cent. antimony metal in the original anode, indicating that the tin had been dissolving preferentially in the bath. The antimony content of the bath also dropped off to 0·1 instead of 3 or 4 g./l, and the bath did not appear to be very satisfactory. They tried putting in a fresh anode for every experiment, which would not be possible in production, and also annealing the anodes. He would like the authors' comments on that, and also their view on whether this chloride-fluoride bath was not so suitable for tin-antimony as the new baths which they advocated for the other tin-base alloys.

Dr. J. W. CUTHBERTSON (Tin Research Institute) emphasised something which he thought had not been

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brought out sufficiently in the paper, namely the reason why they had undertaken this work on fluosilicates. The real stimulus had been the results obtained with fluoborates. The work which Dr. Davies and Dr. Angles had done on tin and tin alloys was leading them to believe that these neglected fluosilicates had advantages over fluoborates. They were rather more stable; they were equally non-corrosive; the chemistry of the baths was simpler; and last, but by no means least, they should be considerably cheaper. All boron compounds were expensive, but there was no reason why, if the demand arose, fluosilicates should not be obtained quite cheaply. It might be worth while for the industry to consider the deposition of other metals, straight metals, from fluosilicate solutions.

Mr. Denyer had referred to a paper which he (Dr. Cuthbertson) had presented to the last Conference, on tin-antimony. It was hardly fair to put questions to Dr. Davies and Dr. Angles on that, but Mr. Denyer might raise them in correspondence with the Institute.

Mr. S. R. GOODWIN (M. L. Alkan Ltd.) referred to the fact that Dr. Davies had mentioned American work on cadmium-tin. He understood that more recently one of the leading American companies had been doing alloy deposition from the alkaline baths, and they had been making what to him appeared to be rather enthusiastic claims about corrosion resistance, which his own investigations had failed to uphold. He understood that the Douglas Aircraft Co. had claimed that using the alkaline electrolyte and depositing 15 per cent. tin, 85 per cent. cadmium, they were getting a deposit of 0·0001 in., which was the equivalent in corrosion resistance to 0·0003 in. cadmium. That seemed to be a wildly enthusiastic claim which he had not been able to substantiate. He had found that the deposit was inclined to be brittle. He wondered whether the fluosilicate bath offered any better corrosion resistance and showed any tendency towards brittleness.

Dr. A. E. DAVIES said that one point in favour of tin-cadmium fluosilicate was that stirring the solution did not vary the composition of the deposit. They had not yet carried out any corrosion tests and he could not make any claims for the deposits in that respect. They had not detected any brittleness from this deposit. They had bent the plate backwards and forwards several times, and the basis metal would break before the deposit. He did not think the deposit was brittle.

THE MECHANISATION OF ELECTROPLATING PROCESSES

By H. SILMAN, B.Sc., F.R.I.C., F.I.M., M.I.Chem.E.

THE author described how the outstanding current trend in electroplating practice is towards the mechanisation of the operations concerned. The advantages of mechanisation are all too obvious but, he said, it may be convenient to list the more important of them.

(1) Reduction of labour requirements, and hence lowered costs.
(2) Improved quality as a result of standardisation of process sequences and thicknesses of deposits.
(3) Reduction of damage through the elimination of undue handling.
(4) Better layout of production lines with lower costs, and less floor space requirements as compared with manual plating lines.

As against these features there are certain disadvantages of mechanisation, although steps can be taken to minimise their effects. The chief of these are:

(1) The relatively high capital cost of the plant.
(2) The difficulty of making a major change in either the type of plating being carried out, or, in some cases, in the nature of the articles being plated.

In deciding whether mechanisation is worth while, careful consideration must be given to the relevant factors and a decision made as to the extent to which the use of automatic or semi-

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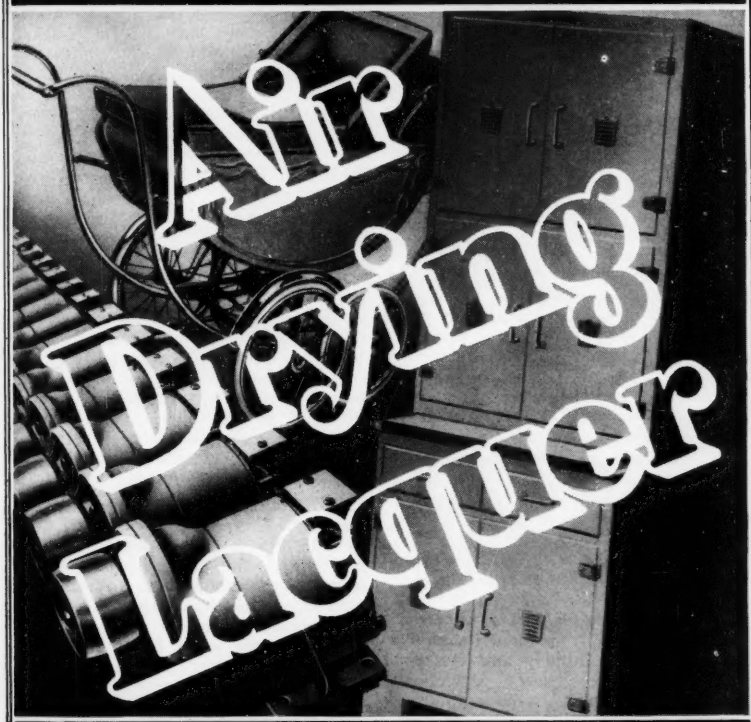

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automatic plant is justified. A most important aspect is the question of continuity of production; where a highly mechanised plant is installed, the capital charges, which may be high, go on whether the plant is in use to its full extent or not. Relatively little economy can therefore be effected in times of low output requirements by reducing the labour force, as can be done with manually-operated installations.

The author went on to deal with conveyors, transfer systems, return and through type plants, size of plant, construction, installation and instrumentation.

DISCUSSION

Mr. N. TOPE (Montgomery Plating Co. Ltd.), said that as a jobbing plater he was very much alarmed at the progress which was being made by the organic and vacuum coating types of deposit and also by the stainless and other non-corroding irons. It was hitting them very hard indeed, because in most cases while those processes were not necessarily superior to plating they were very often cheaper. "They are already," he said, "stepping on our heels, and if we do not do something to reduce our costs they may well step right into our shoes."

The large fully automatic plants to which the author referred were the right thing from the productivity point of view for giants of the industry, but what about the jobbing platers, who were possibly the backbone of the industry? What were they going to do about it? He felt that possibly one of the pneumatically-operated plants to which the author referred, geared up simply to undertake the preplating and dipping and cleaning cycles and post-plating drying-off cycles, feeding return-type semi-automatics or even still vats, might very well be the compromise for which the jobbing industry was looking. They should be relatively cheap and infinitely flexible, because in that way one full automatic doing those initial operations could feed a battery of semi-automatic plants for quite different processes, as for instance, nickel, zinc, cadmium, tin, copper and so on, all feeding off one point into the semi-automatics or still vats and feeding back for finishing off.

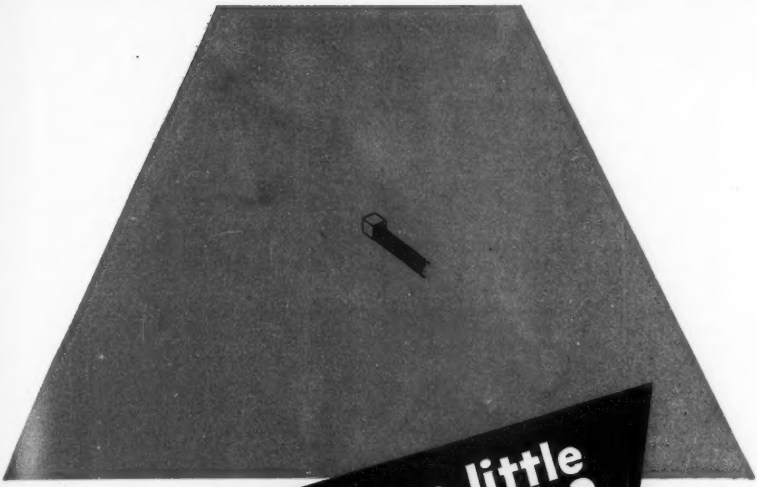
Mr. J. H. GIFFORD (Electro-Chemical Engineering Co. Ltd.), said that one point of great interest in the paper concerned the capital costs of automatics. In this country, even after the recent concession by Mr. Butler in the matter of initial allowances, capital cost was a very important consideration. It should be borne in mind, however, that for a given production a number of costs were common to both hand-operated and automatic installations, as for instance the rectifiers, filters and filtration equipment, busbars, plating racks, plating tanks, anodes and solutions. The difference in cost between hand-operated and automatic plant was represented by the machine which was capable of carrying out the functions of a number of operators in transferring racks through the various processing tanks.

That difference in cost was not so great as might be expected, always assuming that the same degree of filtration and other features such as thermostatic control were used in the hand-operated equipment, which was not always the case. Regard had to be had to both the increased capital cost and the saving in the number of operators required for a given production. If by spending an additional £5,000 on mechanisation five operators could be saved, it would seem desirable to put in automatic plant.

Mr. E. L. MASEK (W. Canning and Co. Ltd.) said it used to be thought that these automatic plating plants were the prerogative of firms with large outputs—the author had mentioned one large firm— and cost a tremendous amount of money. That had been true when there had been straight line plants, with a series of tanks starting at A and going to B

A————————B

and there had to be men at A to put the work on and at B to take it off. Later plants, however, had been of the return type and the same men could put the work on and take it off. It would be seen that there was an immediate saving of labour there. The advent of that type of plant had meant that automatic plant could be used by a great number of people



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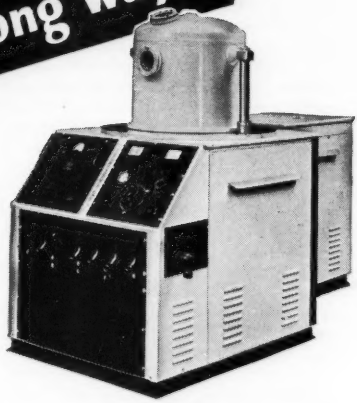

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with smaller outputs, and for people with, say, three 10-ft. nickel vats, it was worth considering.

Both the author and Mr. Tope had referred to the cost. If there were, say, three 10 ft. nickel vats there would be at least four people to operate them at, say, £8 per week each. If, with a return type plant, three of them could be dispensed with, it would mean a saving of £24 per week. If it was quite a modest establishment, with overheads at 150 per cent., to the figure of £24 it would be necessary to add £36, making a total of £60 per week, or £3,000 per annum. It followed, therefore, that automatic plating was not out of the reach of the small shop.

Mr. H. LOW (General Manager, J. P. Fielding and Co. Ltd.) said he felt that he must answer one fallacy put forward by Mr. Masek. He held no brief against automatic plating plants, but Mr. Masek's calculation had been at least misleading, because he referred to a shop having a 150 per cent. overhead rate on wages. Mr. Low did not know what that 150 per cent. included but presumably it included a number of items of cost which were not directly connected with the operators. It might even include such items as electric current, anodes and depreciation of plant. By sacking three operators one would not be relieved of the necessity of buying anodes and using electric current and lighting the shop, while on the other hand one would have vastly increased maintenance costs. There would even be greatly increased personnel costs, because these automatic plants required very strict chemical control, and they also required many months of design and preparatory work. It was, therefore, necessary to give a word of warning. He had carried out in one special case a similar calculation based on an actual itemisation of costs, and he found that the saving was nothing like what had been suggested.

Mr. H. SILMAN, referring to the fact that several speakers had commented on the economy effected by mechanisation, said that if anybody attempted to calculate what mechanisation was going to save on a pure £ s. d. basis by working out the wages of the operators who would be dispensed with he would find, if he did the calculations properly, that mechanisation was a dead loss. That fact must be accepted, and yet the financial advantages of mechanisation were tremendous. In other words, those who thought that it would effect a saving had the right answer, but for the wrong reasons.

STRUCTURAL AND KINETIC PHENOMENA OBSERVED DURING THE ANODIC POLARISATION OF METALS

H. H. THIRSK AND W. F. K. WYNNE-JONES†

†(Laboratories of Physical Chemistry, King's College, University of Durham, Newcastle-upon-Tyne)

DESCRIPTIONS were given of a variety of methods which are useful in studying reactions occurring at electrodes. For the structural investigations involved, the methods of ordinary microscopy, electron microscopy, electron and X-ray diffraction are especially valuable. For following the actual progress of an electrode reaction, the ordinary potentiometric or oscillographic methods may be used, but for both these, it is an advantage to stabilise either the current or the voltage. The application of these methods is illustrated by examples of anodic reactions which have been studied in the Newcastle laboratories. This survey brings out clearly the importance of combined electrochemical and structural studies in elucidating the mechanism of the changes occurring at electrode surfaces. In earlier electrochemical work, the inadequacy of techniques available prevented the exploration of the reaction mechanism under a wide range of experimental conditions. Results illustrate the much greater possibilities arising out of the application of modern methods of experimentation.

THE RATE-DETERMINING STAGE IN THE ANODIC DISSOLUTION OF METALS

By A. HICKLING, D.Sc., PH.D., F.R.I.C., AND J. K. HIGGINS, B.Sc., PH.D.
(Department of Physical Chemistry, Liverpool University)

AN experimental study has been made, using the potentiostat technique, of the limiting current densities of metal dissolution in electrolytic polishing solutions. The limiting current densities show the features expected for diffusion currents, and the effect of the addition of the metal dissolution product to the electrolyte indicates that it is the diffusion of this substance away from the anode which determines the overall rate of the electrode reaction. Electrolytic polishing does not occur until the limiting current density has been reached, and experiments with composite anodes show that the diffusion current densities at peaks in the surface are much higher than at cavities. These observations are interpreted by a simple diffusion layer treatment of the kinetics of the anode reaction, and their bearing upon the mechanism of electrolytic polishing is reviewed. Some practical recommendations for electrolytic polishing are made.

DISCUSSION

Dr. T. P. HOAR (University of Cambridge) said he would like first to comment on the emphasis which Thirsk and Wynne-Jones had put on the need, in all kinds of electrochemical investigation, to investigate the products of reactions at electrodes by chemical and by physical methods as well as doing the more straightforward electrochemical investigation. They had underlined that, and he thought that it was most important. In the usual work which had been done from the point of view of metal finishing, there had not been enough emphasis laid on the structure of, for example, an anodised film on an aluminium alloy, and films of other kinds on different metals. Further, in electroplating itself very little emphasis had ever been put upon the films which occurred as anodes, as for example in the well-known stannate bath for electrodeposition of tin, which depended for its operation on the proper filming of the anodes, yet no one had examined the films on tin anodes dissolving into stannate solution in a thorough way.

Turning to the paper by Hickling and Higgins, the limiting current density curves which they showed, and which agreed so nicely with the concept of a saturated layer of the dissolving salt formed at the electrode, also fitted in very well with the work at Cambridge in connection with the production of the solid film at the beginning of the plateau in electropolishing. It was no accident that the two effects occurred together, and that one had saturation occurring and at the same time, apparently, the complete, compact solid film giving rise to the electro-brightening effect.

Mr. H. D. HUGHES (Metachemical Processes Ltd.) remarked that if the authors felt any diffidence about appearing before the practical men, the practical men had much more diffidence in commenting on their papers. He had been very pleased to find, however, that the theoretical papers which had been given that morning were of such direct practical use and application. He would like to refer to the work done by Thirsk and Wynne-Jones, particularly in relation to the oxidation of lead through lead sulphate to lead dioxide, and to refer to the terrific effect shown in their curves for the potassium chloride solution with or without dextrine, because, unless he was mistaken, the authors must have prepared their lead samples for the work referred to in the previous pages by electrodeposition, and almost inevitably they must have used organic grain control additions.

In some practical work done under the direction of Professor Wynne-Jones seven or eight years ago, in attempting to manufacture a lead dioxide sheet from an electrodeposited lead sheet, inevitable trouble had been encountered because of what had been assumed to be the plating out of the organics, usually of the gelatine type. Were those two phenomena in any

way related, and had the authors gone further, or were they going to go further, to find out what happened under those conditions if the organics were present not in the solution but in the electrode itself? That was of great practical importance.

Professor WYNNE-JONES said that Mr. Hughes had raised a point which was always troublesome, that of exactly what one had on the surface. He thought he was right in saying that the particular experiments to which Mr. Hughes referred had been done with sheet lead and not with electrodeposited lead; most of the experiments had been carried out with electrodeposited lead, but he believed that those particular ones had been done with sheet lead. In general, however, they had made experiments with both sheet lead and electrodeposited lead. They had two reasons for working with electrodeposited lead. One was that they could get a surface which was reproducible in its behaviour to about 2 per cent., which he thought was fairly satisfactory, and the other was that because, as Mr. Hughes knew, PbO_2 was unstable on lead unless there was some tin present, they always had an undercoating of tin. That was important in some of the work. He agreed that they might have difficulties, but he would say that in all their direct oxidation of lead the results which they had obtained were in substantial agreement with the work of other researchers in Switzerland with plain lead.

Mr. S. R. GOODWIN (M. L. Alkan Ltd.) said that there had been a tendency in the discussion to relate the work rather more to electrolytic polishing than to plating, but it had a tremendous application to practical plating.

It was well known that in recent years the trend had been to use organic addition agents in solutions, and there had been a great deal of trouble owing to the use of those organic addition agents. There was a very close connection between the work which had been carried out at Newcastle in particular and the troubles which they had been experiencing, because they had as platers been very concerned in the past with the cathode, which was, after all, the product which they had to supply to their customers, and they had neglected what was taking place at the anode.

When they used organic addition agents they had oxidation and reduction effects taking place, and the formation of what Mr. Wallbank called "degradation products"—decomposition products. The polarisation of the anodes, the oxidation and reduction of the organics, and the further decomposition of the decomposition products were all matters which were affecting their solutions, and this work of investigating what was actually happening should be encouraged and translated into practical terms.

BRIGHT METAL SURFACES AND A THEORY OF BRIGHT PLATING

By T. P. HOAR

(Department of Metallurgy, Cambridge University)

THE nature of bright metal surfaces and the methods available for their production were discussed. It was shown that the production of a bright surface (other than by mechanical working or by rupture at cleavage planes) involves the deposition or removal of surface atoms in a random manner.

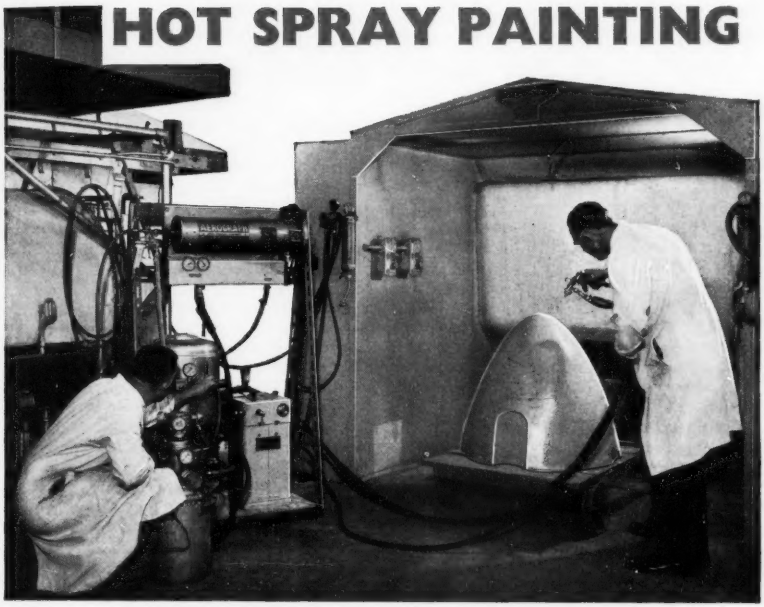
Methods by which random electrodeposition of atoms giving bright plating can be achieved were discussed. A detailed mechanism of the action of addition agents was described, in which it was suggested that two main categories of such agents can be distinguished.

Suggestions for practical advances based on the general theory were made.

DISCUSSION

Mr. E. A. OLLARD (British Non-Ferrous Metals Research Association) said that Dr. Hoar was to be congratulated on having speculated a little on paper about these bright solutions, because many people had been speculating for a long time about them but nobody seemed to have had the courage to write down his speculations. He himself certainly had not.

HOT SPRAY PAINTING



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The photograph shows a corner of the Demonstration Centre with operators hot-spraying synthetic enamels at the water-washed spray-booth. Three types of paint heaters are shown in the illustration. Take advantage of this "know-how" and let us help you to *control* your finish.

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The author said that "plating in the presence of an addition agent does not necessarily use up the agent." Mr. Ollard did not know how Dr. Hoar thought that the supply companies lived! When it was remembered that in an ordinary organic bright solution it was usually found that the brightness charge on a bumper was about 1s., the stuff must be used up somewhere. The brightener disappeared, and it seemed fairly certain that it went into the deposit, but had anybody any quantitative figures?

Mr. H. LOW (J. P. Fielding & Co. Ltd.), said that many of the properties of the bright deposits which had been made could be explained from the thermodynamics of the process of random deposition, such as the increased stresses obtained in bright deposits as compared with dull deposits, the fact that in some of the commercial bright coppers which were used one got better throwing properties, which might be due to the increased energy content of the bright deposits, and also the greater rate of corrosion which caused anxiety in bright deposits might again be explained by energy considerations.

He wondered whether P. R. would not be the way which practical platers could follow, because it occurred to him that P. R. might produce conditions for random deposition without that interference by extraneous agents which would give rise to those increased energy contents which caused practical platers so much trouble in bright plating.

Dr. D. LAYTON (Ionic Plating Co. Ltd.), commenting on Mr. Low's remarks, said that this phenomenon of corrosion was not necessarily due to a higher potential energy of the atoms in the deposit; it might be that organic matter included between the crystal grains was more easily removed by the corrosive processes than the ordinary grain boundaries, where there was a metal crystal in contact directly with another metal crystal. He thought that that point had to be borne in mind.

Dr. A. E. DAVIES (Tin Research Institute) said that in the tin-nickel electrolyte, which consisted of nickel chloride, stannous chloride, sodium fluoride and ammonium bifluoride, there was a critical ratio of fluoride to stannous ions necessary in the solution to produce a bright deposit. If the fluoride concentration was allowed to drop the electrodeposit became dull, and if one made additions of fluoride either up to that critical ratio or well above it one got remarkable brightening in the plate. That might well be due to the excess of fluoride ions adsorbing and desorbing very quickly on the surface, as Dr. Hoar said.

With regard to the use of hydrogen as a brightener, they had observed with the tin-zinc alloys, using a fluosilicate solution that at very low current densities brightness was definitely associated with the evolution of hydrogen on the surface. He had two photographs to illustrate that point. In the regions where there was brightness but it was a rough deposit there was quite considerable evolution of hydrogen. It was probably about 90 per cent. efficient, 10 per cent. of the current producing hydrogen. There was definite brightening, and this was probably explained by Dr. Hoar's theory of the random deposition of the tin-zinc atoms on the surface.

Dr. T. P. HOAR, replied and answered the points raised and said he would conclude with a plea for much more experimental work, and for the use of all possible modern and old techniques, chemical and physical, in the investigation of these addition agent problems.

ECONOMY IN METAL FINISHING

By S. WERNICK, Ph.D., M.Sc., F.R.I.C., F.I.M.

THIS paper, which occupied the whole of the final Saturday morning session, contained a formidable list of items and, as the Chairman pointed out in his opening remarks, these items could be discussed at great length, with particular emphasis on some of them. In point of fact, the discussion went on for the entire morning and the verbatim report of the discussion alone exceeds the total number of Editorial pages in this issue! In these circumstances it is impossible to give a full report and the best that can be done is to offer a summary of the discussion and the points the speakers raised:

Mr. C. WHARRAD (Director;

Britachrome Ltd.), raised the points of communally operated plant, water economy, dull v. bright nickel, the use of insulating agents floating on vats to save gas, the problem of rejects and costs of storage.

Mr. A. W. WALLBANK (Managing Director, Ionic Plating Co. Ltd.), emphasised the importance of overheads, direct and indirect labour and the costs of the factory itself. He pointed out the serious losses through pushing out large quantities of heated air via the exhaust ducts after paying for fuel to heat it. He also referred to the loss of chemicals in the drag-out, rinse and wash tanks, he again emphasised the cost of rejects.

Mr. E. A. OLLARD (British Non-Ferrous Metals Research Association), said it was no use spending £5,000 on a conveyor system if the one man it saved spent the equivalent time smoking in the yard, a thing which often did happen, the question of mechanisation needed careful thought, he said. He also discussed layout, supervision, fuel saving and keeping labour up to scratch.

Mr. H. A. MANNING (Holmes Plating Co. Ltd.), described the benefits his firm had observed from lining and brick casing their hot tanks to cut down fuel consumption. He also described a scheme they had developed for using the cooling water from a diesel plant to supply vat heating water.

Mr. A. F. BROCKINGTON (W. Canning & Co. Ltd.), spoke on the subject of automatic plants and the costs connected with them.

Mr. G. SCHMERLING (Chief Chemist, Silvercrown Ltd.), said he thought insufficient attention was being paid to the question of current density. He suggested that standardisation could possibly be arranged by always loading work so that it totalled a pre-determined area regardless of whether it was one casting or a hundred small items.

Mr. R. J. BROWN (Chief Chemist and Metallurgist, Morris Motors Ltd.), spoke on the special needs of the motor industry and compared painted and plated finishes in this country and the U.S.A., he made a plea for cleanliness and stimulation of research.

Mr. R. WALL (Hall Telephone Accessories Ltd.), dealt with the value of recording results and using records to save costs. He also dealt with the human element and the cost of rejects.

Mr. A. WALMSLEY (Burco Ltd.), spoke of the economies possible in the water consumption of a plating shop, and by melting and using up small ends of polishing compounds.

Dr. T. P. HOAR (University of Cambridge) described the ways of designing swill tanks to save heat losses, and to avoid using several tanks where one could be adapted.

Mr. H. J. BACHE (Electro-Chemical Engineering Co. Ltd.), spoke about pumps, filters, degreasants and rinsing and also put the case for the smaller type of automatic plant. He discussed the use of spray rinses and described their advantages.

Mr. H. LOW (General Manager, J. P. Fielding and Co. Ltd.), spoke on the desirability of knowing what the work was going to be like before giving quotations and he also described his experiences with customers and the questions of rejects and lost work pieces. A suggestion he put forward was that manufacturers should pay more attention to the protection and painting of tanks.

The second Biennial Safety and Factory Efficiency Exhibition is to be held at Bingley Hall, Birmingham, on 19th-26th June. Over forty commercial exhibitors have booked space whilst, in addition, some thirty stands will be occupied by members of the Birmingham and District Industrial Safety Group. In conjunction with the exhibition, a congress will be held dealing with "Training for Safety and Health in Industry." Amongst the exhibitors are many firms whose names are familiar throughout the finishing trades.

Prizes amounting to £2,250 are offered in this year's Industrial Art Bursaries competition. The prizes are available as travelling bursaries valued at £150 each and are open to students intending to take up industrial designing as a career. The closing date is 12th October, 1953. Details of the awards and conditions of candidature with full supplementary information are contained in the 1952 report, available from the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.1.

THE PRESSED METAL INDUSTRY

THE third report to appear from an American Productivity Team visiting this country is concerned with the Pressed Metal Industry. It covers in a fairly balanced manner their views on company organisation and management, materials handling, plant layout, tool design, safety, and labour conditions. The team noticed the English pride in craftsmanship and the importance of maintaining high quality levels; it further comments on the fact that almost without exception managers or undertakings in the country were younger than those in a comparable position in the United States.

Wherever pleasantries of this kind occur they may be accepted as evidence that we are not always behind American industry but that in many respects British practice is either equal to its American counterpart or in advance of it.

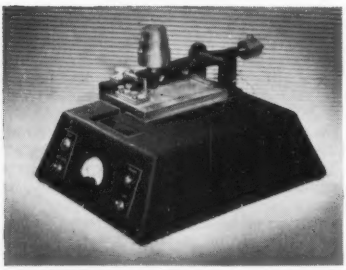
Nevertheless, the critical content of the report can be noted profitably. Improvements are suggested in tool design and criticism is made of the barrier-type safety guards: the suggestion here is that certain safety considerations could be embodied in tool design.

The plating and polishing departments visited, were, almost without exception, noted to be well lighted, clean and equipped with the most modern plating and polishing equipment. The British plants, in general excel their American counterparts in this respect.

Priced 3s. post free, the report is available from British Productivity Council, 21 Tothill Street, London, S.W.1.

POWER-OPERATED SCRATCH TEST APPARATUS

OUR photograph shows the "Rel" power-operated apparatus in which the test panel is drawn forward by power under the weighted scratch point. This principle ensures that the speed of movement of the panel is constant and consistent from one specimen to the other, and not variable as in the hand-operated type.



The apparatus is available for operation on 230/250 volts A/C., and is provided with mains switch, test switch and a reverse switch to return the panel after test. A special leaflet is available from the makers: Research Equipment (London) Ltd., 64 Wellington Road, Hampton Hill, Middlesex.

ADHESIVE DUSTERS

WE have received, from Adhesive Dusters Ltd., of Dudley, Worcs, samples of a new type of adhesive duster which is being placed on the market, this is claimed to be effective for a considerable period and to be impregnated in such a manner that it can be used until it is practically black. Samples and details can be obtained from the manufacturer.

BARREL PROCESSING

THE editorial staff of a specialist journal such as INDUSTRIAL FINISHING has a great quantity of trade and technical literature in the form of textbooks, leaflets, pamphlets, brochures, instruction books and catalogues, passing through its hands in the course of a year.

The technical quality of this literature varies from the highly academic text book to the simple trade booklet; in the latter field the principal aim of the work is to help sell the products of its sponsor and, in many cases it unashamedly does just that and no more. Occasionally, however, we come across a work in this category which sets out to do rather more than sell. A publication which is of value for the sake of the information it contains, often on a little known subject, or for the working instructions for this or that process.

A recent work which falls into this class and is outstanding in the practical value of its content is the new "Hand Book on Barrel polishing, Finishing, De-Burring and Burnishing" issued by R. Cruickshank Ltd., of Camden Street, Birmingham. This little book gives a description of the various processes, a list of the jobs and methods which are applicable to the barrel techniques, an analysis of the advantages and disad-

vantages of various barrelling media, considerations involved in the choice of barrel type and size, tables of working speeds, racking and jigging procedures and a host of other facts relative to the barrel process.

It is well illustrated with photographs of typical barrel finishing equipment, illustrations of the type of article suitable for processing, curves of surface profiles and cut-away diagrams of special plant such as that used for submerged barrel burnishing, etc. It is a book which should prove of considerable value to anyone interested in the possibilities of barrel finishing.

HOT SPRAY PAINTING

WE are advised by T.C. Spray Finishing Systems, the makers of the S.F.S. Bede hot spray unit that the price of this unit has been reduced from £150 to £145. This has been possible due to increased production and the consequent savings in material purchases, etc. The savings being passed on to the user as part of the company's policy.

In the same connection a combined handbook, maintenance manual and spare parts list has been prepared for the Bede equipment and copies of this are available from the manufacturers. The manual contains information on the installation, initial setting up, upkeep and operation of Bede paint heaters and is well illustrated by both photographs and line drawings.

INDUSTRIAL CHAIR

HERE is something new in industrial chairs—something that will appeal to the woman operative from the point of view of comfort, convenience and appearance. This chair has many unique features not usually found in seats of this type and the woman operative will be particularly pleased with its comfort and with the facilities in the chair, for stowing and locking away hand-bags, shoes, etc.

The main advantage, apart from these features, and its appearance and upholstered comfort, is its adjustability over a wide range of heights for seat position, back-rest position and foot-rest position—all being controlled independently. Adjustment is simple and can be carried out easily by the operative herself, and whatever job is being done and whatever size the operative, she can be accommodated comfortably and easily.

The chair is finished throughout in chromium, and the seats and back-rest

upholstered in a wide range of attractive colours. The sides of the locker are also finished in polychromatic colours to complete a very pleasant piece of factory furniture. The chair can also be folded flat in a very few seconds, and this is another advantage for storing and carrying, and it means that movement from one part of the factory to another can be accomplished, if necessary, by the operative herself and without any effort. The makers are: Vitrolec Ltd., 261 Victoria Road, Aston, Birmingham 6.

NEW DIAPHRAGM TYPE COMPRESSOR

A NEW diaphragm type compressor built to provide small quantities of low pressure air completely free from oil and other impurities has been introduced by the Hymatic Engineering Co. Ltd. Designated the DP4, it is intended for such duties as food processing, raising consumable liquids, pressurising instruments or special equipment and for many special processes in medical or industrial laboratories.

The new compressor has a three-ply diaphragm which takes the place of the usual cylinder and piston, thus avoiding the necessity for the presence of oil in the compression chamber. The connecting rod is an aluminium alloy casting shaped into a circular disc at the upper end upon which the diaphragm is seated. At the top of the compression stroke, the disc conforms to the contour

of the diaphragm which has its outer extremities nipped between the main casting and the compressor head. The plate holding the diaphragm in position on the disc also houses the ring-type inlet valve, the ports being carried through the diaphragm and the connecting rod head. The connecting rod is split at the bottom to accommodate the sealed grease-packed ball race constituting the big end bearing. The hollow overhung crankshaft is located on the rigid driving shaft of the ⅛ h.p. B.T.H. motor by a key and central bolt. The main bearings are again grease-packed. An activated carbon air intake filter furnishes an additional safeguard to purity.

The aluminium alloy head sealing the compression space houses the low lift diaphragm type delivery valve and a special chamber designed to damp out pulsation. Fitted with twin cylinder air receivers, each with its own drain cock, built in relief valve and recessed pressure gauge, the compressor unit is mounted on the spigot of the electric motor. A pressure switch is available as an extra, adjustable to between 0 and 30 p.s.i. and for the differential between cut in and cut out.

The maximum working pressure is 30 p.s.i. at 1,450 r.p.m. Delivery is 2 cfm of free air at 10 p.s.i.—the equivalent of 200 gal. an hour liquid displacement. The air outlet connection is ¼ in. B.S.P.

The outstanding feature of the new compressor is its silence in operation. There is no perceptible vibration as both crankshaft and connecting rod are carefully balanced. Servicing is rarely necessary during the life of the unit since no lubrication is required at any point and there are no moving parts in rubbing contact.

Besides the specialised applications for which it was designed, the portability and compactness of the new Hymatic DP4 enable it to be used for other duties in sites inaccessible to the standard type of air compressor.

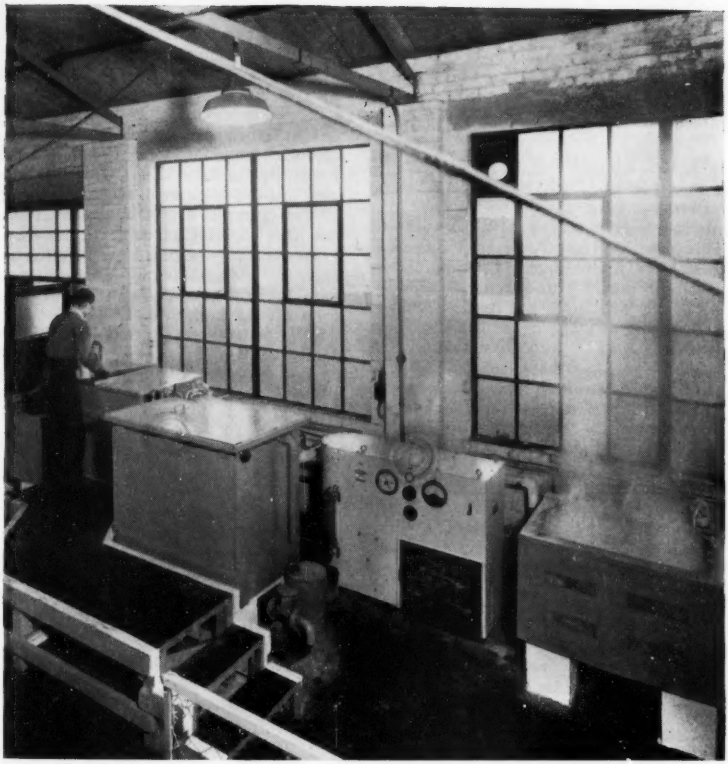
Steam Raiser for Plating Shops

THE use of steam for heating plating vats has become established as the method most likely to give close control of temperature, an important factor in plating procedure.

The supply of steam is often taken from the fuel-fired boiler installation which also provides for space heating and other domestic purposes. It is, however, wasteful in a good many industrial premises to supply steam from this source for the plating plant as the run from the boiler house to the plating shop is, as often as not, exceptionally long. Most planning engineers quite rightly place the plating shop in some remote corner of the works or in separate premises removed from the main production shops in order to meet the regulations regarding the enclosure and sealing off of such equipment.

To run a steam line for such a distance can be uneconomical due to the heavy radiation heat losses, and furthermore, there can be little or no guarantee that the steam pressure and temperature will be constant. In addition, a fuel-fired boiler would need to run throughout the summer months, when the requirements for space heating are negligible, just to supply the plating plant. The solution lies in having a steam producing unit actually in the shop adjacent to the plating plant. Such equipment, of the electrode boiler type, gives precise control of temperature and pressure and requires no attendant labour whether skilled or otherwise.

The electrode steam raiser manufactured by the Boiler Division of G.W.B. Electric Furnaces Ltd., of Dudley, Worcs, under the trade name of Autolec, is an example of this type of equipment. From the illustration it will be seen that the unit is compact, entirely self-contained in a cream stove-enamelled casing of pleasing appearance, and has the controls neatly arranged on the front panel. It is virtually noiseless, can produce steam from cold in a few minutes, and can be shut down imme-



diately there is no further need for the supply of steam.

In many plants, the vats are kept warm during the non-working hours by means of insulation so that a short boost before work recommences each morning will bring them up to the required temperature. This boost can be brought into operation automatically by arranging for the steam raiser to switch itself on at a pre-selected time.

Automatic control deletes the necessity for constant supervision as, once the steam raiser has been switched on, thermostats in the vats themselves will ensure that the vats are maintained at the precise temperature required. In this way several vats, each for a different plating process and therefore at different temperatures, can be heated from the same steam raiser.

The efficiency of the electrode boiler is very high since the whole of the electricity used is converted 100 per cent. into heat within the water itself, the only losses being by radiation and convection from the boiler shell, which is carefully lagged, and this results in an overall efficiency of 98 per cent. This unit is fully protected by safety devices and it is impossible for it to burn out, in the accepted sense through shortage of water, due to the fact that any absence of water in the boiler shell breaks the circuit and no load is taken by the equipment.

Autolec steam raisers have a standard range which extends from 30 kW to 1,000 kW units on low tension supplies, up to 600 volts, and above 1,000 kW, they are usually designed to operate on high tension supplies. The output of L.T. units ranges from 100 lb. up to 3,350 lb. of steam per hour.

RESEARCH on

PICKLING, HOT DIPPING AND TIN COATINGS

THE Annual Report of the British Iron and Steel Research Association contains much to interest the operator of pickling and hot dipping processes. The Coatings Committee has been active during the year in the field of pickling and acid recovery.

Much attention has been given to conserving acid in sulphuric acid pickling and its recovery from waste liquor. It has been concluded that the best method of recovering unused acid from waste liquor is to evaporate the liquor to high acid strength, by either submerged combustion or a heat exchanger, whereupon ferrous sulphate separates out as the monohydrate. The method appropriate for a particular works depends on the fuels available and the use to which the ferrous sulphate is put. In this respect the size of crystal is important. It has been found that the submerged combustion method forms crystal aggregates, whereas the heat exchanger method yields very small single crystals. Laboratory experiments are being carried out to determine the optimum conditions for producing large single crystals of ferrous sulphate monohydrate.

The influence of bath composition on the rate of pickling is being studied and it is hoped to establish, amongst other things, the optimum concentrations of acid and ferrous sulphate for any desired pickling speed. Results so far obtained indicate that an increase of 10 per cent. in the acid strength over that normally used in present practice may permit an increase of 50 per cent. in the pickling rate.

Behaviour of Tinplate Service

The Association is paying special attention to the electro-chemical behaviour of tinplate when in service in food containers. Particularly with regard to the effects of discontinuities in the tin coating and the character of the food packed. The Isotope Division of the Atomic Research Establishment at Harwell has tested for the Association a possible method of assessing the area of steel exposed at pores in tinplate. A tinplate specimen is immersed in a solution of a radioactive cobalt salt. As cobalt is below iron, but above tin, in the electrochemical series, deposition of cobalt by chemical displacement occurs only on the iron exposed at the pores in the coating. It is hoped to assess the area of steel exposed at the pores by measuring the total radiation from such a specimen and comparing it with that from a known area of steel similarly treated.

The possibility of depositing alloy coatings by electrodeposition has been studied and some success has been achieved in depositing alloys of iron and zinc. The coating is hard, strongly adherent and for low zinc contents is very bright. The surface of the steel base needs no special preliminary treatment, such as buffing, becausing of the "smoothing" action of the deposit. Increasing the zinc content of these alloys improves their corrosion resistance, generally with diminishing brightness. A provisional patent application has been filed for the methods used for co-depositing iron and zinc.

The Hot Aluminising Process

Laboratory experiments on aluminising single steel sheets indicated that the process is feasible and revealed some of the problems likely to be encountered on an industrial scale. The information gained from these tests has been applied to the continuous aluminising of narrow strip, up to 2 in. wide and 400 ft. long, and wire in a small pilot plant at the Swansea Laboratories. A film of glycerol is applied to the strip by passing it, after cleaning, between two small rubber rollers which revolve in a small tank of glycerol. The glycerol burns quietly when the strip or wire enters the molten aluminium. No attempt has so far been made to regulate the amount of coating, but plans are in hand to embody a wiping arrangement at the exit end for this purpose.

A particularly attractive feature of aluminising for certain purposes is that the time and temperature of

aluminising enable steel which has been heavily cold-worked to be annealed at the same time.

The success of the method of coating the ingoing steel with glycerol has suggested that the technique might be applied to continuous galvanising and possibly to continuous tinning. These ideas will be tried later.

A simple and efficient method of reclaiming zinc from zinc dross has been devised. Zinc dross is an alloy produced in the galvanising pot by the inter-action of zinc with iron from the container, the rig, and the steel being galvanised. It contains 94 per cent. zinc and 6 per cent. iron, is heavier than zinc and sinks to the bottom of the pot. If allowed to accumulate, the dross would impair the quality of the galvanised articles; it is therefore periodically removed. In the new method of reclaiming zinc, the dross with some aluminium is added to a bath of lead and the whole is heated to about 720° C. The aluminium combines with the iron in the dross to form an alloy which floats on the top of the bath and is skimmed off, the zinc being dissolved by the lead. The bath is then cooled and the zinc separates out and solidifies and is easily removed. A patent application has been filed to cover this process.

The Metallurgy of Coatings

The properties of hot dipped coatings on steel depend principally on the distribution of the alloy layers. Results have shown that with pure aluminium coatings, hard and thick intermetallic layers are formed which preclude its use as a coating for steel which may subsequently be deformed. If silicon is added to the aluminium bath the alloy layer is reduced and softened.

It has been shown that under tension the composite coating behaves well but that under compression there is a tendency to wrinkle and fracture. As with galvanised coatings, the degree of flaking depends on the relative thicknesses of the outer and alloy layers but whereas with zinc fracture occurs between the alloy layer and the steel base, with aluminium the plane of weakness is within the alloy layer itself.

MATERIALS HANDLING

THE Institution of Mechanical Engineers heard the James Clayton Lecture for 1953 delivered by James R. Bright, M.S., M.A.S.M.E. Mr. Bright is the chief editor of *Modern Materials Handling*, Boston, Mas. In speaking to the title, "How American Industry is Attacking Materials Handling," he emphasised that the handling of materials is really one of the basic activities of mankind and as such a common denominator to all industries. In America it was being realised that materials handling often represented the biggest individual cost item in both manufacturing and distribution. He showed that for one plant the time spent under this heading accounted for an annual consumption of 8,133,060 hours, this compared with 4,000,000 hours devoted to testing, the next largest operation.

A further point made by Mr. Bright was that apart from immediate cost considerations, handling frequently became a bottleneck between processes, or between processing and storage. Careful consideration of these problems is essential and the purchase of equipment should only be undertaken when the engineer is satisfied as to its suitability.

He emphasised that packaging also has its contribution to make towards solving these problems.

Croda Ltd., Snaith, Nr. Goole, Yorkshire, now have a metal priming paint giving a flat finish, the "Metox." It is claimed to have high anti-corrosive and rust inhibitive properties. It surface dries in two hours and may be handled safely after four hours. Particular applications are for structural steel, drums, kegs, barrels and identification purposes. It has a flash point of about 97° F. and a viscosity in the range 75-85 sec.

A British Standard for polythene tube for general purposes, including chemical and food industry uses, is available. It is B.S. 1973/53. Polythene tubes in black, white, and natural, are provided for in composition, dimensions, limits and testing features for various weights. Price 4s. from 24 Victoria Street, London, S.W.1.

OIL DRUM RECONDITIONING

DRUM Reconditioners Ltd., a Company formed some eighteen months ago, now has at Colnbrook one of the most up-to-date works in Great Britain for the reconditioning of oil drums and steel barrels. The most recent addition to its equipment is a G.E.C. infra-red plant which stoves the drums after repainting.

The 40-45 gallon drums when they arrive for reconditioning are loaded on to powered conveyors and carried right through the plant. Whilst in movement they are subjected to a number of specialised operations designed to give them a thorough external and internal cleaning and to restore their original shape. Finally, they are passed through a shot blaster to remove all external residue of rust and paint, and fed into a two-man spray booth where they are hand sprayed before being carried through an infra-red oven by an overhead cable conveyor.

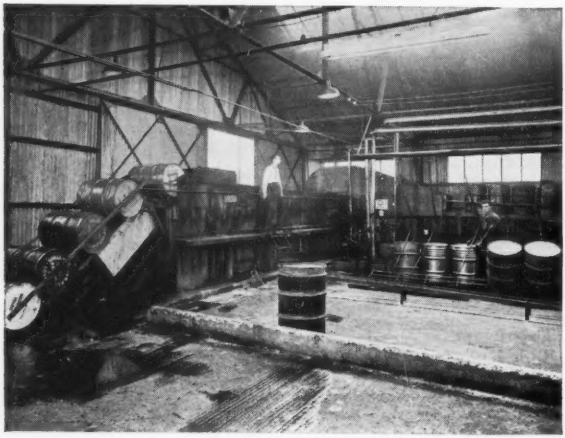


Fig. 1. 40-gallon oil drums stacked on a moving conveyor pass through a caustic bath prior to reconditioning

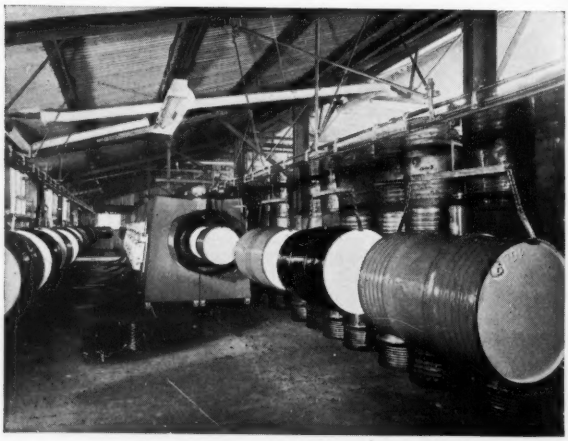


Fig. 2. Drums suspended from the 194 ft. long conveyor passing through the infra-red oven. The individual switchgear for each panel of heating elements can be seen in this picture

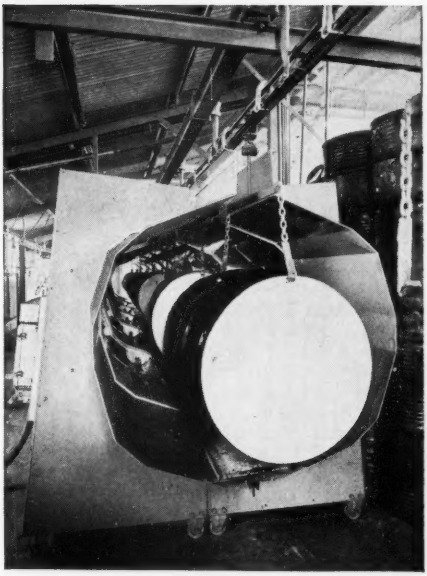


Fig. 3. Close-up of the G.E.C. infra-red oven showing the sheathed wire element heating troughs

The oven, thirty-six ft. in length, has a maximum loading of 288 kW and consists of sheathed wire element troughs mounted in six foot panels. At each end of the oven there is a three foot vestibule. As usual with an oven of this type, it is built in two sections, each of which has four rows of heating troughs and is mounted on a wheeled floor-stand. The troughs are inclined at angles to each other so that when the two sections are together they form a tunnel roughly octagonal in shape. A recessed channel at the top of the tunnel accommodates the travelling cable conveyor from which the drums are suspended at four foot intervals.

The drums, after spraying, are first given a flash-off period of five minutes, then stoved for three minutes at full heat and finally left to cool for ten minutes, after which they may be handled. Some two hundred drums per hour are stoved in this manner.

The Spring Number of "Chez Nous" heralds its appearance with a strikingly colourful front cover. In addition to its home news and events, the overseas companion companies of Pinchin Johnson Associates are well displayed. In particular are their activities in the larger fields of paint application—notably road and rail transport—shown most impressively in the centre page of illustrations.

Nine new shades appear in the shade cards of "Pammel" and "Blunkote" distributed by Blundell, Spence and Co. Ltd. Two of these are modifications to previous shades and the remaining seven are additions to the range, and appear in lighter tones, mist green, mist blue, mist grey, mushroom, pale rose, blush and light stone. The enamel and hard-gloss finishes now tie up with the "Permastic," plastic emulsion coatings.

W. Canning and Co. Ltd., Great Hampton Street. Birmingham 18, announce a new industrial skin soap and a chrome ointment. The soap, No. 3338, is offered for use by operatives engaged in electroplating, acid pickling, bright dipping and other similar trades, for the prevention of dermatitis, blisters, septic abrasions and so on. It is available in four sizes. The chrome ointment is for application to parts of the body affected by chrome sores or dermatitis, and is available in two sizes.

The accounts department of London Metal Warehouses Ltd. has moved from its location in Crowthorn, Berkshire, to the head office of the company at Summer Road, Thames Ditton, Surrey.

American Finishing Developments

A DIGEST OF THE ARTICLES DEALING WITH FINISHING PROCESSES, WHICH HAVE BEEN PUBLISHED IN U.S.A. TECHNICAL JOURNALS.

Barium Peroxide in Nickel Bath for Enamel Ware Conserves Nickel Salts

Three American enamel plants have taken advantage of the benefits derived from the use of barium peroxide to control a nickel bath, a process recently developed by chemists of the Chicago Vitreous Enamel Product Co., Chicago, Illinois. Because barium peroxide controls such nickel bath factors as *p*H and ferrous sulphate content and eliminates the formation of sodium sulphate, tank life can be considerably prolonged and the consumption of nickel salts reduced.

Performance under actual working conditions was observed for a two-month period, during which about 450,000 sq. ft. of ware was processed in an 1,800 gal. nickel tank. Results of the tests showed that preparation of metal for the enamelling process was less troublesome, the general appearance of the pickled ware was much improved, there was a higher degree of and uniformity of the bond development, and better quality of the texture of the fired ground coat enamel.

The method of control is as follows: The *p*H and ferrous sulphate concentration of the nickel bath are determined, and the nickel tank is heated to the temperature at which it is normally operated. Barium peroxide is then added in the form of a water slurry on the basis of about 1 lb. for every 1,000 sq. ft. of ware processed daily in a 2,000 gal. capacity nickel tank. The treated solution is filtered continuously. When precipitate settles to the bottom, the clear solution is siphoned off and the residue discarded. Once a day, the *p*H and ferrous sulphate concentration of the treated solution is checked, two or three hours after making the required additions. In this way, it can be determined whether the amount of barium peroxide should be increased or decreased.

(*Better Enamelling, August,* 1952.)

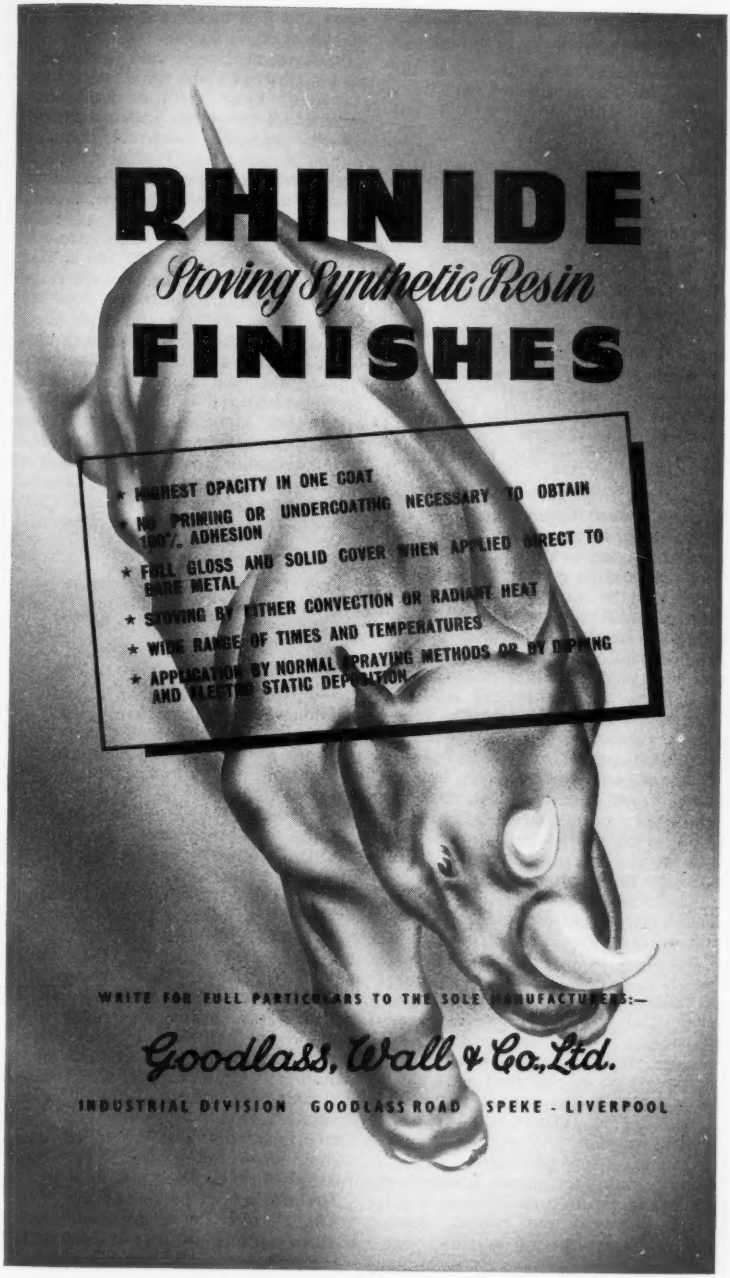
Recent Developments in Aluminium Paint

Several recent developments have extended or improved the application of aluminium paints. One of these is the possibility of adding low-tint chromates without any change in the brightness and whiteness of the aluminium itself. Formerly, when mixed with zinc chromate, aluminium lost its brightness and became mud-yellow in colour. Now that chromates may be added successfully, aluminium paint becomes a true anti-corrosive, and the necessity for using undercoats and primers is eliminated.

Another recent development is the possibility of making "coloured" aluminium paint. This is done by adding bright, heat-resistant, pigments, such as phthalocyanine blue or green to non-leaf aluminium paste, producing attractive metallopolychromatic industrial finishes with good weather-resistance. Such "coloured" aluminium is useful for painting radiators and pipes.

Some of the newer vehicles or binders for aluminium paint are chlorinated rubber, vinyl, acrylics, polystyrene, and silicone. These vehicles are useful for special applications, where ordinary oleo-resinous varnishes would not do. However, most of them may not be pigmented with more than 1 lb. fine-mesh aluminium. Another drawback is their slightly "frosty" appearance with aluminium.

(*Paint, Oil and Chemical Review, 9th October,* 1952.)


RHINIDE
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FINISHES
★ HIGHEST OPACITY IN ONE COAT
★ NO PRIMING OR UNDERCOATING NECESSARY TO OBTAIN 100% ADHESION
★ FULL GLOSS AND SOLID COVER WHEN APPLIED DIRECT TO BARE METAL
★ STOVING BY EITHER CONVECTION OR RADIANT HEAT
★ WIDE RANGE OF TIMES AND TEMPERATURES
★ APPLICATION BY NORMAL SPRAYING METHODS OR BY DIPPING AND ELECTRO STATIC DEPOSITION
WRITE FOR FULL PARTICULARS TO THE SOLE MANUFACTURERS:—
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INDUSTRIAL DIVISION GOODLASS ROAD SPEKE - LIVERPOOL

Epoxy Resins Improve Surface Coatings

Synthetic resins that contain oxygen in the form of epoxides (oxygen attached to two different atoms of a chain) are improving surface coatings. According to the Shell Chemical Corpn., New York, this group of resins—known either as epoxy or Epon resins—open new fields to the paint technologist.

The Epon resins may be used in two ways to produce superior coatings: (1) by converting unesterified Epon resin with a suitable catalyst or with such heat-convertible resins as phenol-formaldehyde, or urea-formaldehyde; or (2) by reacting Epon resin with fatty acids to form "Epon resin esters." This is made possible by the reactive epoxide and hydroxyl groups in the Epon resin molecule.

There are two types of unmodified Epon resin formulations, one based on heat co-reactive resins, and the other based on reactive amines, producing room temperature cure. Heat reactive resins such as urea- or phenol-formaldehyde will convert Epon resins on baking. These coatings offer exceptional solvent and chemical resistance combined with hardness, flexibility, and adhesion. One typical formula produces nearly water-white films having outstanding chemical resistance, such as withstanding boiling 20 per cent. sodium hydroxide, boiling water, 36 per cent. hydrochloric acid, and 10 per cent. nitric acid. In addition, it is unaffected by an impact of 28 in. lb. and ⅛ in. mandrel bend when on 20 gauge steel or tin plate.

The other formulæ, based on reactive amines, cured at room temperature, are the latest development in the field of Epon resin finishes. The cure occurs without oxidation and therefore permits extremely heavy coats. The vehicle is light in colour and finishes in white or pastel may be produced. In a typical such coating, the reactive amine is packaged separately and is added to the vehicle just prior to use. This formula has shown excellent results as a primer and as a topcoat. It has good adhesion and flexibility and compares favourably with baked Epon resin finishes in its general chemical and solvent resistance. The weathering qualities are good and it is unaffected by 2,000 hr. of salt spray.

In reacting Epon resin with fatty acids to form "Epon resin esters," the choice of Epon resin is determined by the film properties and the desired vehicle properties such as viscosity and acid number. Typical of these esters is a medium-long oil type having good flexibility and weathering properties combined with superior toughness and abrasion resistance. It performs well as a vehicle for indoor and outdoor enamels, and as a floor finish. Another short-oil type is desired especially for use with urea or melamine resins in baking formulations. It may also be used in air dry applications, but is not suitable for brushing because of the solvent. Suggested uses include industrial baking enamels and primers, tube enamels, clear overprint vehicles, implement finishes, and tin decorating enamels. (See also article Vol. 5, No. 55, p. 426).

(*Paint, Oil and Chemical Review,* 20*th November,* 1952.)

"Wash Primer" Shows Considerable Economies in Facilitating Paint Adhesion

"Wash primer," a conditioner or pretreatment coating for metals, is showing excellent results in increasing the adhesion of protective paints to metals; however, because of the unfamiliar basic nature of this chemical coating, its adoption has been slow. This primer is adapted to a wide variety of hard-to-finish metals, such as stainless steel, aluminium, zinc, cadmium, tin, magnesium alloys and galvanized iron.

Developed by the Bakelite Division of Union Carbide and Carbon Corpn., New York, its sole purpose is to increase the adhesion of other coatings. Normally green in colour, "wash primer" is essentially composed of basic zinc chromate pigment in a solution of polyvinyl butyral resin, and is supplied in a two-compartment container. One compartment holds the resin component; the other holds phosphoric acid solution. To thin the primer, the acid is added and stirred slowly, on site. The site mixture must be used within 8 hr.

The primer may be applied by spray, brush, or roller, to conditioned metal. It dries rapidly so that considerable

economies can be achieved in drying schedules. The pretreatment may be applied to damp surfaces, but not to those that are wet, and should be applied only to clean metal surfaces, within 24 hr. of cleaning. Some vinyl topcoats require a special intermediate coat to obtain good adhesion.

This resin - chromate - phosphate solution exhibits outstanding adhesion properties because of the quality of the resin itself in this respect, and to the slight etching of the surface by the acid component which creates excellent anchorage. When applied over steel, the rust-inhibiting film of iron phosphates, caused by the action of the acid on the metal, helps to develop a tight, adherent, bending surface for overcoating. Originaliy developed as a highly adhesive undercoating for sea-going boats, "wash primer" has also been used successfully with hot plastic paints.

(*Industrial Finishing* [*U.S.A.*] *November*, 1952.)

Plastics Transform Wood Into Attractive Translucent Doors

Plastic resins and reinforcement are making otherwise porous woods sturdy and attractive enough for the doors of houses. The doors are warp-proof, shatter-proof, moisture-proof, and corrosion-resistant. They permit light to penetrate dark entrance halls without interfering with privacy.

At the Cover-Lite Co., Danville, California, a door-sized panel is first made of soft porous pine. The panel has several inches of wood surround to give it a flat frame, and it may have any interior cut-out pattern the architect desires. The patterned core is cured in an autoclave.

After pouring phenolic resin on the absorbent wooden pattern, pressure is applied to impregnate it completely and to achieve a homogeneous wood-and-plastic pattern. Following this, two translucent laminated sheets of fibrous polyester glass are applied to the frame, one on each side; and the assembly is fused electronically and chemically with a permanent insoluble phenolic resin binder that forms a complete seal. The sheets may have any one of a number of available colours.

(*Modern Plastics, December*, 1952.)

Automatic Heat Treating Line Has Duplex Quench for Either Oil or Water

A new line comprising a batch leader; a continuous heat treatment machine; automatic oil or water quench tanks in duplicate, side by side; and a washing machine; provides the ability to change rapidly from oil-quenching and washing one type of bolt to water-quenching another type, and is providing considerable economies as compared with previously used batch treatment in salt pots. The equipment was designed and installed by American Gas Furnace Co., Elizabeth, New Jersey, in the plant of Russell, Burdsall and Ward Bolt and Nut Co., Port Chester, New York. This plant makes a large variety of metal screws, bolts, and fasteners.

The four-stage automatic system of batch leading; heating; quenching in oil or water as the needs require; and cleaning or degreasing, already produces 670 lb. of shackle bolts per hour. It is expected that hourly production will soon increase to exceed 1,000 lb. per hour, the output varying with the heating cycle, quenching time, and the nature of the product being treated.

The oil-quench tank is a complete unit welded alongside the water-quench tank. The combination tank is mounted on wheels and can be moved sideways, back and forth. Steam coils in the oil tank maintain the specified temperature. Provision is made through hose connections for filling, draining, and circulating the quenching mediums.

The double tank saves the time needed to empty and fill a single quench tank, and avoids the conditions which arise when oil and water are interchanged in one tank. Each tank has its own complete conveyor system. Heated work from the rotary retort falls through a chute whose lower end is immersed in the quench. An automatic seal, which is spring loaded, prevents air from reaching the work as it passes into the quench. It is so constructed that when the tank is moved to one side or the other, the seal is also transferred. Vapour arising in the chute from the oil is burned by an exhauster.

The treatment line incorporates a new type of loader. An overhead crane places tubs of components on the cradle of the loader and tilts each tub so that the work falls into a rotary hopper, which is of sufficient size to accommodate half-an-hour's supply. The hot retort itself is fed from this hopper by an internal scoop —a little at each rotation. Heating time is controlled by the variable-speed drive that operates the retort.

Emerging from the quench, the work falls into a washing machine. When the water-quench tank is used, the washing machine simply becomes a drier.

Based upon a minimum hourly production of 750 lb., the estimated cost of treating shackle belts amounts to less than ½ cent. per lb., exclusive of the slight additional cost of the washing machine, its maintenance and operation.

(*Metal Progress. November*, 1952.)

HEAT RESISTANCE?

by E. JOHNSON

QUITE often the impossible is expected of a heat resisting paint. On the other hand, paint users with modest requirements are surprised how much the average good quality finish will endure. There is no doubt that during recent years the performance of the so-called heat resistant paints has improved, and in the future the outlook will naturally be for still greater heat resistance and durability.

With the ordinary everyday types of industrial finish, the term "heat-resistant" mainly applies to paint materials supplied to the finisher of gas and electrical fires, irons, and heaters, etc., mainly for domestic use, or any other appliances that may attain a surface temperature of anything up to the boiling point of water. For this class of work the paint manufacturer supplies a material which comes under the heading of heat-resisting, low-stoving synthetic enamel, which can be cured by convection stoving at 230° F.-250° F. for periods ranging from 30-60 min., or by radiant heat processing somewhere around the 4-min. mark. Usually, the spoiling temperature of this type of paint is about 320° F., although unless specially formulated for heat resistance breakdown may occur under this figure. Variations, or modifications in the formulation are necessary to cope with other demands on the finish according to the requirements of the user.

The term "heat-resistant" is quite meaningless unless qualified. It could easily apply to temperatures from below the freezing point of water up to over 1,000° F. In some circumstances, refrigeration for example, a temperature of 60° F. might be considered hot, whilst for furnace work a temperature of 1,000° F. may be considered to be normal or even low. Therefore, it is quite clear that in covering all attainable temperatures there is no such thing as complete heat resistance. Sooner or later every substance undergoes a change and gradual decomposition begins, this is not always apparent to the naked eye.

Heat resistance, as generally understood, does not mean permanent resistance to unlimited heat, and the term should be clearly defined to the user of a paint who may ask for a protective finish for wares which will bear an inscription "heat-resistant." This may be a selling point, but the label of course is really meaningless. This brings up the question of what are the conditions which are covered by the general term "heat-resistant."

It has been suggested that a paint may be regarded as having good resistance to heat if the paint retains its nature and properties, and fulfills its protective functions for a reasonable period, when subjected to periodical peak temperatures of anything up to 500° F. However, it must be realised that paint is applied for

reasons of corrosion prevention, plus some decorative appeal, and under normal conditions, not to confer protection against the effects of heat on the surface to which the paint has been applied. This is a very important point, and another, often overlooked, is that a paint can only protect a surface up to the temperature at which the surface itself starts to break down.

Paint materials are, for convenience sake roughly divided into two classes. Those hardening by heat being known as thermo-setting, and those that are softened by heat, being regarded as thermo-plastic. However, there is no definite and distinct line of demarkation between the two as quite a few materials may show both properties over varying ranges of temperature. To quote a simple example of this, iron and other metals may be made plastic at certain temperatures, but after cooling may not be regarded as thermo-plastic in comparison with a paint applied to its surface. Allowing for expansion when stoving paints, the metal is not regarded as being thermo-plastic at these comparatively low temperatures by the finisher. A paint film may be both thermo-plastic and thermo-setting and still break down through carbonisation at various temperatures.

The ideal paint film of course would be one of a reversible thermo-plastic nature at temperatures up to 500° F., which is high enough to cope with average conditions encountered by the industrial finisher, but as materials of this type are affected by heat and light, they gradually lose their properties and decompose. Paints based on drying oils and synthetic resins have very poor thermo-plastic qualities once they dry out. Those drying by oxidisation at ordinary temperatures react almost completely within 24 hr. The change by polymerisation of oil and oil-modified resin films becomes rapid under elevated temperatures and produces a highly inert product within a very much shorter period.

This curing by heat results in an increased strength of the polymerised product, but only up to the point at which the curing is complete. Beyond this stage, further heating will only have a weakening effect on the paint film, until the structure eventually disintegrates.

It is popularly supposed that for a particular paint there is a maximum temperature below which the paint should last indefinitely. But the breakdown of a paint film depends on time as well as temperature. This may take the form of long exposure to a moderate temperature or a shorter exposure to a high temperature, but eventually break down will occur. The principle effect of exposure to heat is the gradual loss of adhesion, although phosphate-treated metal and metal etched by abrasive methods will undoubtedly hold the paint film to a greater extent than the untreated metal.

Allied to adhesion is the gradual diminishing flexibility and changes in tensile strength. A paint film must be able to adjust itself to the thermal expansion of the underlying surface, and this may be fairly considerable with some metals. Such expansion naturally stretches the paint film and, if not allowed for, will pull the paint away from its foundation. As the film hardens, such adjustment must operate in reverse, so that the paint film reverts to its original dimensions when the surface cools. In the face of this it must be realised that to a great extent the heat resistance of the film is partly dependent on its flexibility, which is simply a matter of adjustment in formulation, if that would meet the requirements of the user.

This seldom happens, and it is not easy to specify a type of paint for its heat-resistant qualities alone, as so much depends on the factors already mentioned, together with an allowance for other needs. Whilst one type of paint may be entirely satisfactory for a particular set of conditions, some modification will be necessary if any other factor, such as water resistance, for example, is also involved. A paint which will give excellent service to one user may be totally inadequate for the requirements demanded by another, although heat resistance may be the prime objective in both cases. It is usually the other factors that decide the issue and these are mainly found only after experiment and exposure to these conditions.

In determining the make-up of a paint, if time does not allow for the somewhat lengthy tests, the formulation must be based on information received as to the estimated priority of the various conditions the paint will have to meet. If heat resistance is the most important factor, certain types of media and pigment are ruled out at once. Should moisture, in excess of normal atmospheric conditions, have to be considered in addition, the number of available materials is narrowed down still further. Also, some degree of resistance to acid, alkali, oil, etc., may come into the picture too: in fact quite a number of things can be involved, although heat resistance may have to be the dominant factor.

To cater for all the added requirements of a heat-resistant finish it is generally necessary to sacrifice something. This is unavoidable—the paint has yet to be made which will satisfy every demand to be made on it, and even price has no bearing on the matter. Every paint chemist hopes that someday he will produce a paint that is heat-proof; water-proof; totally resistant to ultra-violet light; and all the other "proofs" that are almost unlimited in number. If this should ever happen—theoretically it is impossible—we should then have the perfect paint. As we cannot have everything in one can, we can only examine the materials that are available—pay our money and take our choice.

To examine, or even mention, all available materials would take unlimited time, and convey very little to the reader; therefore a brief mention of the accepted standard paints which come under the term "heat-resistant" may suffice for those who are interested in the finishing of normal products, the surface of which is subject to moderate heat.

The materials available that combine water and heat resistance to a fairly high degree are naturally not in the lower price range of paints, but the difference in cost, which is proportionally little, will be well worth while if a good all-round resistance to average conditions is obtained. This of course, must include colour retention and gloss, as eye-appeal is very important.

A phenol-formaldehyde type can be considered to have excellent heat resistance and good water resistance. If exposed to sunlight, this type is inferior to the urea-formaldehyde, melamine, or alkyd types; or the blends obtainable from them. In addition, its colour retention is weak in comparison with the three types just mentioned.

In the medium price-group the melamine materials will give very good all-round service and the skilful blending of alkyd with both melamine and urea-formaldehyde types, suitably pigmented of course, produces paints that give very satisfactory performances under average conditions. This group of materials are suitable for both dip and spray application, and stoving schedules average 250° F. for 30-45 min. for convection and 3-4 min. radiant heat, according to the nature of the article to be processed.

The ordinary bitumens and pitches have rather low softening points and are not very suitable, but the blown or oxidised bitumens, especially if pigmented with aluminium paste or powder, produce very good heat-resisting paints at a relatively low cost. Gilsonite, raphaelite, etc., the high melting point asphalts, are excellent for heat resistance, either alone or used in combination with drying oils, and these are extensively used under the title "high temperature black"; application mainly by dipping, and stoving somewhere around the 400° F. for 1 hr. mark

In a class by itself at the moment, as regards heat resistance, is silicone enamel. Whether or not this will become the general-purpose heat-resistant material of the future depends very largely on the price being very much reduced. At present prices of £16 or more per gallon are being quoted, and whilst experiments to reduce the cost by blending with other resins have so far had little success, there is hope for the future that the gap between the aforementioned low stoving types, and the silicone types available, will be shortened by "boosting" other resins with silicone.

Apart from its price, the processing

(*Please turn to page* 824)

THREE COAT PAINT SYSTEM FOR TRANSFORMERS

THE American Westinghouse Corporation have developed a new type of finishing system for their transformer casings. Mr. J. G. Ford, manufacturing engineer for the Corporation said recently: "It was developed specifically for use on small distribution transformers which lower the voltage of electric current so it can be used safely in homes.

"Even under the most severe climatic conditions the new system will more than double the life of the finish on distribution transformers. Test samples of the new paint, exposed continuously for eighteen months on the sea-coasts of Florida and California, showed absolutely no sign of corrosion. Appropriately, the new system has been named 'Coastal Finish'."

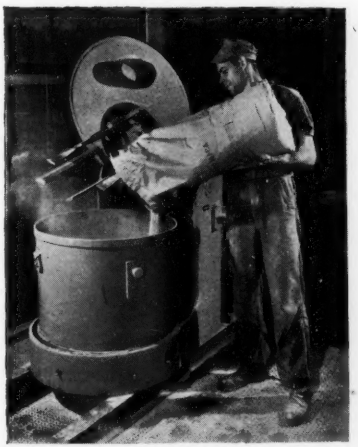
Key to the success of the new system is the middle layer of paint which is made up of mica flakes embedded "shingle roof" fashion in a syrup-like plastic. The mica flakes ward off the attacks of moisture and oxygen, principal causes of rust, and increase the heat resistance of the middle coat as much as ten times at high temperatures.

The new system works as follows:

The transformer first gets a coat of special primer that clings tightly to the steel surface and seals it from contact with the air. The second coat, with its pigment of mica flakes, then is applied and allowed to dry. Finally, the third coat is applied to give the transformer a pleasing finish and to shut out ultraviolet light from the sun's rays.

Development of the new painting method will help solve the third

Mica flakes are emptied into the container prior to mixing with the plastic medium



Two panels after test of two thousand hours continuous salt water spray, right hand is new system

major problem of engineers in the protection of transformers.

"The three major causes of transformer failure in the field," Mr. Ford pointed out, "have been 'burn out' as the result of electrical overload, lightning strokes and corrosion. Engineers have the first two problems well under control. The new painting system should go a long way to solving the third."

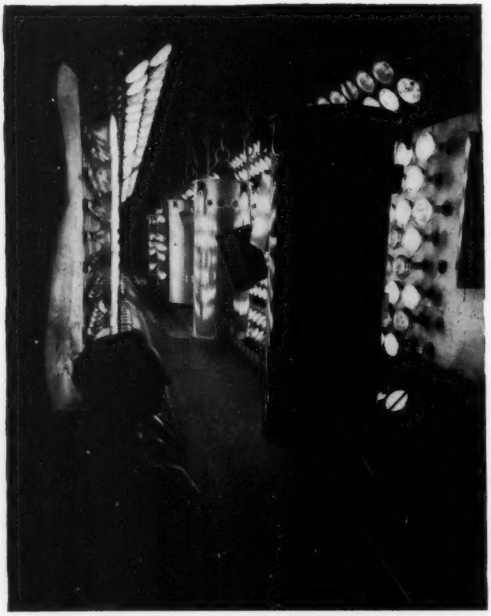
A long series of tests both in the field and in the laboratory, were applied to the new finish before engineers were satisfied with the results. In addition to exposure on actual sea-coasts, the finish was subject to accelerated life tests in the laboratories, including simulated fog, salt water spray, freezing cold, acid and alkali resistance and temperatures above those of boiling water.

In one case it required 10,000 hr. of continuous exposure to salt water spray before the mica-based finish showed any signs of deterioration. Standard finishes, on the other hand, were 50 per cent. gone after only 2,000 hr. exposure.

(*Above*) *Completed transformers after* 1,000 *hours salt spray; left hand is the new system, right hand the standard*

o
o

(*Right*) *The first coat is baked on by infra-red, the mica flake coat follows and a final gloss coat goes on the top*



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Our mica powders give added protection against corrosion, and assist in preventing disintegration of surface coatings at elevated temperatures.

★ ★

Other important properties include their value as anti-settling agents where heavy pigments are present, and as additives to such metallic pigments as aluminium and bronze.

★ ★ ★

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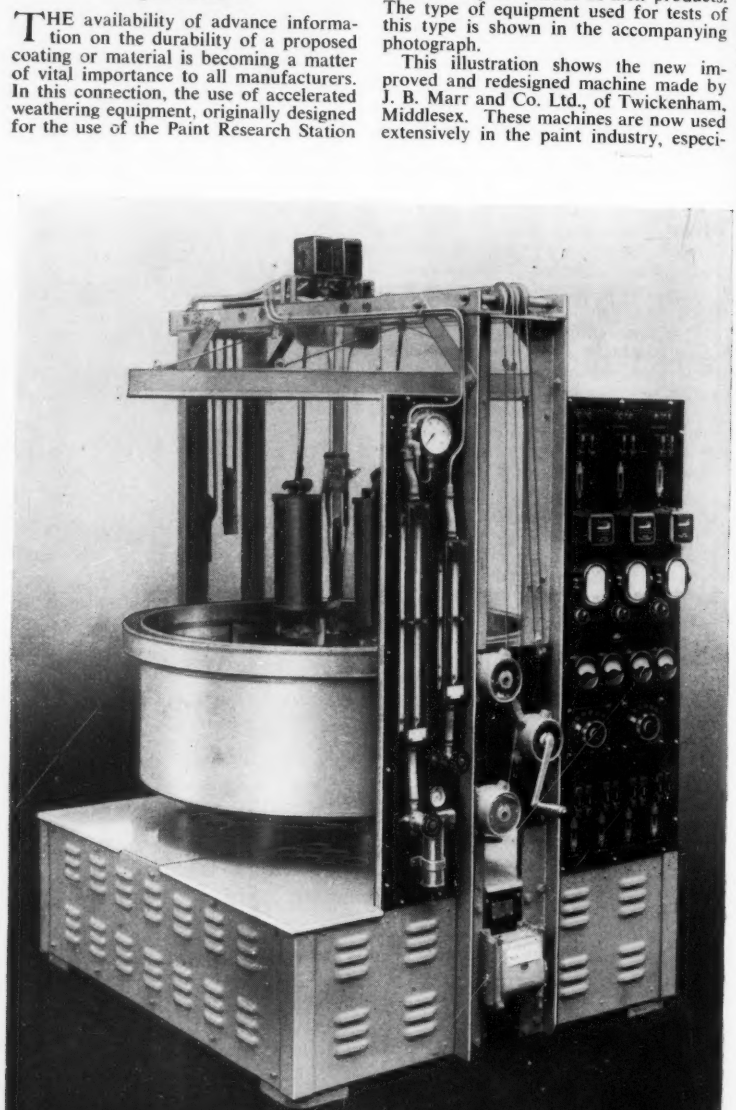
ACCELERATED WEATHERING EQUIPMENT

THE availability of advance information on the durability of a proposed coating or material is becoming a matter of vital importance to all manufacturers. In this connection, the use of accelerated weathering equipment, originally designed for the use of the Paint Research Station at Teddington, has increased considerably the ability of manufacturers to forecast results and performance of their products. The type of equipment used for tests of this type is shown in the accompanying photograph.

This illustration shows the new improved and redesigned machine made by J. B. Marr and Co. Ltd., of Twickenham, Middlesex. These machines are now used extensively in the paint industry, especi-



ally for the testing of paints manufactured under Government contracts. Similar equipment has been supplied to the leading chemical, motor-car, plastic, tarpaulin, cable, electrical manufacturers, etc.

The "Marr" equipment is a complete self-contained unit that can easily be fitted into any laboratory without costly installation work. The apparatus consists of a 4 ft. diameter drum which can be rotated on a vertical axis at various speeds. Inside the drum is a removable rack capable of holding 120 6 in. × 3 in. specimen panels or samples of any type of material to be tested. The drum, its cover and the sample racks are all made from galvanised or stainless steel. The drive mechanism which runs on ball-bearings is totally enclosed and designed for continuous operation.

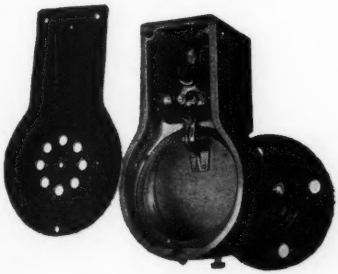
One to four enclosed arc lamps each of 900 or 2,000 watt size are suspended inside the drum together with high pressure and/or low pressure liquid sprays to simulate rain, sea air, etc. The lamps are arranged eccentrically so that the intensity as well as the sequence of the light exposure may be varied with the rotation of the drum. The control panel incorporates adjustable time switches in arc lamp spray circuits, these can be set to any pre-arranged sequence and they are linked with direct reading hour recorders which eliminates the personal element in keeping logs of the exposures.

Other refinements include air and water flow meters and pressure gauges, ammeters and voltmeters in the arc lamp circuits. All metal parts can be supplied in stainless steel. The drum cover and lamps are suspended from the overhead gantry and can be raised and lowered by self-sustaining winches. The whole equipment which is built on sound engineering principles is attractively finished in grey enamel with chromium-plated fittings and black bakelite instruments.

It is of particular interest to note that this type of research is no longer only carried out by the manufacturers of various materials, finishes, etc., but by the actual users of these commodities who appreciate the importance of being able to obtain advance information regarding the durability of the materials they are using.

A. B. Fleming and Co., Ltd.—have acquired a new factory at Corstorphine, near Edinburgh and are to transfer the manufacture of lithographic inks from the present Granton factory to the new site, the move will provide scope for development at the Granton factory.

AIR FLOW SWITCH



DETAILS ON REQUEST

● **This switch operates as a protective device in all cases where the maintenance of a continuous flow of air is of importance.**

● **A totally enclosed mercury switch ensures absolute reliability even under the most adverse conditions of dust and dirt and also provides complete protection against risks of explosion through sparking contacts in an atmosphere charged with inflammable vapours.**

● **The switch may be used in an ambient temperature up to 350° C. and will operate on a differential as low as 0·1" w.g.**

● **The mechanism functions on air pressure or suction against the restoring force of gravity; no springs of any kind are used.**

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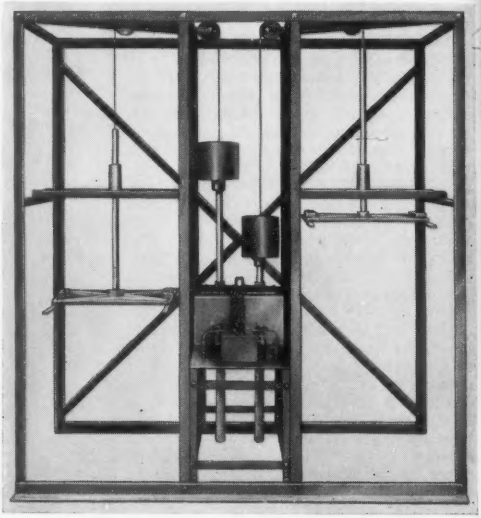
DIPPING MACHINES FOR VACUUM COATING INSTALLATIONS

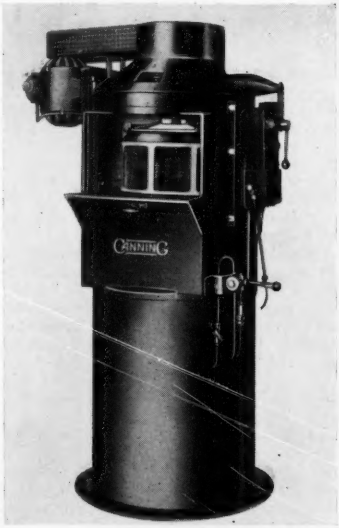


FOLLOWING the publication of our article on vacuum deposition processes (March issue), we have received the following photograph from Lionel Hook and Sons Ltd., of Ebley, Stroud, Gloucester.

The example illustrated is their "Cotswold" Mark VI model which has two tanks and two sets of mechanism each of which is independent of the other. It is suitable for work up to 23 in. long using tanks up to 26 in. × 30 in. surface area. It is, of course, fully capable of handling long or short work.

The makers inform us that they are supplying a considerable number of these machines specially for use in the vacuum coating industry, for which the class of machine is unusually suitable.

DIP LACQUERING MACHINES



TWO machines of a different class which also may have an interest for firms considering vacuum coating equipment are the centrifugal dip lacquering and drying machines illustrated here and made by W. Canning and Co. Ltd.

Designed for lacquering small parts in bulk, these units will deal successfully with almost any shape of article other than flat plates or deeply recessed or cup-shaped parts. The apparatus may be used with cellulose, synthetic and gum lacquers, the motor and switch gear being manufactured to the requirements of the cellulose and petroleum regulations. Approximately thirty loads per hour can be dealt with, the articles usually being spun for 30 sec. in one direction and 30 sec. in the reverse direction and then removed from the apparatus to complete drying. The raising and lowering of the lacquer chamber of this unit is mechanically operated.

The No. 2 size is similar in principle to the machine just described and is suitable where large quantities in bulk are required to be handled. In this case the raising and lowering of the lacquer chamber is carried out by an internal hydraulic unit.

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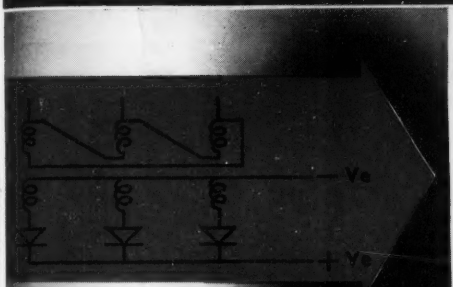

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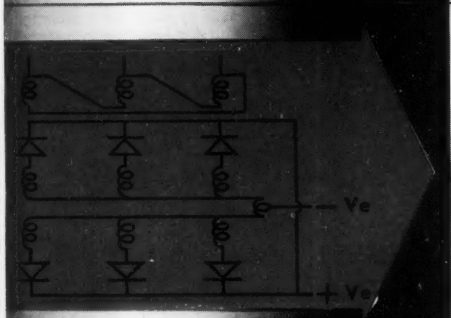

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NAMES IN THE NEWS

Appointments

B.E.N. Patents Ltd., following extensive reorganisation, have made the following appointments to the sales staff of the company:

Mr. W. Ludlow Taylor is now sales supervisor covering the technical sales and service representative throughout England, Scotland, Wales and N. Ireland. He has been with the company since 1937 and was their representative on sales service covering seventeen counties. **Mr. R. W. Deane** has been appointed sales and service representative for Scotland. Before joining B.E.N. Patents Ltd. he was with the Regent Oil Company in a similar capacity. **Mr. J. B. Herbert** is now representative on sales and service for Cambridgeshire, Essex, Hertfordshire, Norfolk, Suffolk. He was at one time with the Hymatic Engineering Co. Ltd. **Mr. J. A. H. Baily** covers Cornwall, Devon, Gloucester, Monmouth and Somerset. **Mr. B. R. Garratt** is responsible for Derbyshire, Hereford, Shropshire, Staffs, Worcester and Warwick. **Mr. D. F. Taylor**, formerly with the company at High Wycombe, will act for Berks, Bucks, Oxfordshire and Wiltshire. Sales representatives for other areas remain unchanged.

Mr. B. R. Garratt

Mr. W. Ludlow-Taylor

Mr. P. T. Bliss was recently appointed sales director of G. A. Harvey and Co. (London) Ltd., after serving as sales manager for a number of years. He joined the company in 1909, is a member of the Incorporated Sales Managers' Association and of the Incorporated Advertising Managers' Association.

Mr. W. J. Branscombe, managing director of Pinchin, Johnson and Associates, has been appointed to the board of the Fishburn Printing Ink Co. Ltd., Watford, with **Mr. Frank Ingham Clark** as alternative director. The appointments ensure a close working association between the Fishburn's and Robt. Ingham Clark and Co., and the mutualisation of their interests in the metal coatings' field. In this respect both companies hold common ground and technical collaboration will be established.

Mr. G. V. Bloomfield has been appointed senior development engineer on the technical staff of the Hymatic Engineering Co. Ltd. He is 28 years of age and has been engaged on fundamental research into the atomisation of fluids and on spraying techniques for fluids and powder. Hymatic's aircraft equipment and their work on high temperature air reducing valves and high pressure compressors were also his responsibility.

Mr. G. V. Bloomfield

Mr. Geoffrey Sergent, formerly with Marconi Ltd. at Chelmsford as planning engineer, has joined the staff of T. C. Spray Finishing Systems as chief engineer.

(*continued from page* 816)

cost of silicone enamel is rather high. Application is by spray generally, although roller-coating is possible, and the stoving schedule is in the region of 600° F. for 2 hr., or 450° F. for 4 hr. The shorter stoving cycle being the more preferable to obtain the maximum performance from the enamel. There is no discoloration at this temperature and the water resistance is excellent. It should be mentioned that silicone enamel is not brushable in the strict sense of the term. Touching-up with a soft brush is possible, but this material has poor levelling qualities.

It is a feature of this material that the gloss is undoubtedly rather poor as against the low stoving synthetics, but to offset this, silicone enamel has very good adhesion, excellent weathering properties, and is heat resistant at temperatures of 1,000° F. for lengthy periods.

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Floor space required for plant: approximately 80 ft. × 30 ft.
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